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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

OCTOBER 25

London Branch (Junior Section) :—First meeting of the session at 49, Wellington Street, London, W.C.2. Address by the Chairman, H. R. Slater, and Lecture by H. G. Summers on "Foundry Practice."

OCTOBER 26.

Lancashire Branch (Junior Section) :—Presidential address by R. A. Miles. "Large Castings made by Jolt-Ramming Methods," Paper by A. L. Key.

East Midlands Branch :—Ordinary meeting at Derby "The Loss of Money and Lack of Progress due to Ruie-of Thumb Methods in Ironfoundry Practice," Paper by H. J. Young.

Birmingham, Coventry and West Midlands Branch :—Ordinary meeting at Birmingham. "Coal-Dust in the Foundry," Paper by B. Hird.

NOVEMBER 2.

West Riding of Yorkshire Branch :—Ordinary meeting at Leeds. "The Solidification and Cooling of Metals," Paper by Professor A. Campion.

Lancashire Branch :—Ordinary meeting at Manchester. "Some Aspects of Modern Foundry Practice," Paper by F. Griffiths.

The Business of Making Steel Castings.

A correspondent in one of the Chamber of Commerce "Journals" asks for the percentage of Continental steel castings used in British shipbuilding practice. According to the Board of Trade figures, there were 1,002 tons of steel castings imported in September, 1928, whilst the output for that month, as reported by the National Federation of Iron and Steel Manufacturers, was 12,500. This shows that the importation is operating to the extent of 8 per cent., and probably represents the figure asked for by the correspondent referred to. Now the effect of such a figure is far-reaching, as it tends to set the price for the British market. According to Mr. Ernest Wells, the situation is aggravated by the small-scale founder, who carries but small overheads consequent on the impossibility of his assuring foreign representation, and can undersell in the home market his large-scale competitor. Without referring to any official records, we would assert that the main competition in this line is from Belgium, which also competes in the international market. The question obviously arises: Is there a case for an application to be made under the Safeguarding of Industries Act? There has recently been formed a loosely-constructed employers' federation for the steel castings industry, which is perfectly competent to set the ball rolling. But certain founders feel that such an action, if successful, would be of considerable help to the inefficient. This group of founders represents a school of thought which postulates the slogan, "Modernise and make good castings or get out of business." On economic grounds, it is as well to remember that there exists in Great Britain an enormous reserve of semi-derelict plant perfectly capable of making substantial profits under boom conditions. Is the retention of such plant worth while? If boom-period profits are applied to modernisation, then for normal conditions there would be created a manufacturing capacity greatly in excess of demand; if it be scrapped, then a shortage of plant may result. Each condition is equally undesirable, but the subject surely demands something more than the present-time *laisser faire* attitude. To illustrate some of the economic factors, which are truly extraordinary, it is only necessary to cite the following, taken at random. One Sheffield steel foundry is shutting down, whilst another is worried about quoting reasonable deliveries; Scotland is ordering steel castings from the South of England, whilst an engineering firm within 60 miles of the foundry in question is purchasing large quantities of these from Czecho-Slovakia. The Belgian founders are faced with a large loss of labour due to the National Exhibition building contractors, who are under penalty to finish their work by May next year. Thus one could continue the elaboration almost *ad infinitum*, yet every statement indicates in no uncertain way the definite need for an employers' federation to rationalise the economic structure of their united enterprises.

Whither Trending?

It has frequently been pointed out that the founding art in its early stages was of an entirely empirical nature; the men who practised it, from Abraham Darby onwards, learnt their job as it grew. Their method was one of trial and error, until such time as they had pieced together the elements of practice that were necessary to ensure the assembly of the charge, successful melting, and the proper preparation of the mould. Gradually, however, the art spread, and as it became more general efforts were made to make it cheaper. Competition led to further development, and when practice had gone as far as it could by itself science was brought in to help. We can distinguish three main periods in the development of founding since science took a hand in the game. During the first, work was carried on with the object of determining the precise influence of those elements which are invariably found in a greater or less degree in cast iron—silicon, phosphorus, manganese, carbon, etc. This period necessarily overlapped with the next, which was devoted to ascertaining how far the material could be further improved by the addition of other elements than those that owed their presence to their inclusion in the original ore. These elements—nickel, chromium, titanium, vanadium, etc., were either added independently or used in a measure to replace certain elements originally present in the pig. It appears from recent work that we are about to enter upon a third period, which may well serve to explain completely the behaviour of cast iron, by explaining differences that are found but which are not due to differences in composition. These differences arise from the circumstances of melting. They may be due to differences in melting temperature, to differences in pouring temperature, to the presence in the melt of solid matter, finely or coarsely divided,

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to the influence of coke on the melting, affecting the pick-up of carbon and its presence in the melt in the combined or uncombined form, to the influence of ferro-alloy additions either at the top of the cupola or in the ladle, and so on. Naturally, these three periods of development cannot be sharply divided from one another either by date or by any other means, since they overlap. The first great line of development mentioned, however, may be said to have begun with the work of Professor T. Turner on silicon additions. The second followed this closely, although the complete exploration of the field has had to wait for our own day. The third period is only just beginning, and we believe that foundrymen during the next ten years may well experience all the interest and excitement that follows on the development of comparatively novel ideas and the practical trial of those ideas. Technical discussions and meetings are likely to be stimulated in consequence, to the general benefit, and in particular to the benefit of the industry in its endeavours to meet the competition of other materials.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Rotating Melting Furnaces.

To the Editor of The Foundry Trade Journal.

Sir,—Replying to Mr. Smeeton's letter in your issue of October 17, in which he evidently resents the space you have devoted to the description of the Brackelsberg furnace, I would like to say that this publicity has been kindly given by you without any solicitation on my part, and was undoubtedly due to your own actual knowledge of the results attained in Germany.

Mr. Smeeton speaks of the Brackelsberg furnace rather contemptuously as a "younger brother," and mentions an earlier patent relating to a furnace which he says can be fired by gas, oil, electricity or powdered fuel, but surely many attempts have been made in this direction, and if Mr. Smeeton will take the trouble to investigate, I think he will find that the Brackelsberg furnace is but part of a process covered by at least eight patents issued, or pending, and that the success of this "younger brother" has been due to constant use in some of the best European foundries by men who are expert in the founder's art.

The Brackelsberg furnace is in actual use by many of the largest foundries in Germany, and licences have also been granted to firms in Austria, France, Italy, Switzerland and the United States.

Castings made by this process are specified by the German Government, and one of the largest —probably the largest motor-car manufacturer in Europe—uses only Brackelsberg castings, which are also supplied through German foundries to British manufacturers who are eagerly awaiting the production in this country.

The great commercial success attained by the Brackelsberg furnace and process is apparent to all, and firms operating under these patents are not liable to risk their capital in experiments or become involved in any patent litigation.

Mr. Smeeton was very bold in his comparisons and in the claims that he makes for the Buess furnace, and I would ask him to say where one of these furnaces is in actual continuous operation. I know that two or three have been installed, but where is there one in actual use?

I thank you very much for the publicity you have kindly given to this process in the past, and would like to repeat that this has been done without any solicitation on my part and without any suggestion, either direct or indirect, of advertising in your columns.—Yours, etc.,

J. D. Brackelsberg,
p.p. Charles F. Lumb.

Malaya House, Admiralty Arch,
London, S.W.1.
October 18, 1929.

[Our motive seems to interest both Mr. Smeeton and Mr. Brackelsberg. We had no object in publication other than that of acquainting British industry with the fact that rotary furnaces in general constituted a development of which foundry executives should be cognisant. This correspondence must now close.—Editor.]

Efficiency of British Works.

Mr. Robert Hamilton, the newly-elected President of the West of Scotland Iron and Steel Institute, in the course of his presidential address, delivered in Glasgow on October 18, said that the United Kingdom made more pig-iron in 1880 than it did in 1927. The highest output was in 1913, when a total of 10,250,000 was produced. It was only in 1890 that the U.S.A. passed Great Britain by a small amount, and for the following seven years there was little difference between the two countries, but in 1901 the American output was double that of Britain, in 1916 it was four times as much, and in 1922 it was five times; that proportion was being fully maintained. Germany, including the Saar, passed Britain in 1906, and doubled the British output in 1927; France passed Britain in 1924, and had kept ahead ever since.

In steel, the United States passed Britain's production in 1886, doubled it in 1899, trebled it in 1905, quadrupled it in 1909, quintupled in 1922, and was now maintaining that proportion. Britain was still ahead of France, but that country was creeping up, and in 1927 its production was fully 8,000,000 tons, compared with fully 9,000,000 tons for Britain.

What were the causes of the British decline? One was the expansion of the industry in those countries which were naturally well situated and provided with raw materials. There was also the desire of countries to produce their own iron and steel. This tendency towards increased national independence had developed considerably since the beginning of the present century. With regard to charges of inefficiency in Scottish blast-furnace practice, it was alleged that Scottish furnaces were too small and their outputs the lowest in the United Kingdom. The furnaces were certainly small, but not too small when the conditions under which they worked were remembered. There used to be a scarcity of coking coal in Scotland, but when the furnaces were erected there was a plentiful supply of good splint coal, and they were designed to work with this. They still did so, with a consumption of coal as low as good coke practice. Larger furnaces had been tried, but they were too high and could not be worked full. The majority of Scottish furnaces were between 60 and 70 ft. high, and that was as high as the so-called splint coal now being supplied would stand. He knew of no facts which proved or even indicated that the British industry, seen against the background of its own problems and possibilities, was less efficiently organised or less ably directed than that of America or any other country.

A New Large Nitriding Furnace.

A large nitriding furnace, reported to be the largest in the world, has recently been constructed by the Central Alloy Steel Corporation at its works at Canton, Ohio, U.S.A. The furnace will be employed for the promotion of the use of nitralloy, one of the new alloys the Corporation is producing under Krupp licences. The size of the furnace permits the nitriding of parts up to 23 ft. long, including such large pieces as cross-head guides for locomotives.

Random Shots.

Whenever there is an Inventions Exhibition in London large quantities of space are devoted to it in the popular Press, and I have often wondered what it was all about. Having a few minutes to spare one day recently, and being in the neighbourhood of Caxton Hall, therefore I dropped in to see. There were a certain number of really useful ideas, that will, I suppose, find their way slowly into everyday life. There were also a number of comparatively trivial gadgets and devices—by no means all of them new—of the class that everybody admires as ingenious and nobody employs as invaluable! There were even some—tell it not in Gath—that were not particularly ingenious! The exhibition struck me chiefly as being the happy hunting ground of what might be called the outside or non-technical inventor—the inventor who is not in any way engaged in the trade to whose advancement he desires to offer a contribution. . . . I fear that the lot of this type of optimist is often hard. . . .

* * *

Nevertheless, I was interested to see that a silver medal and second prize had been awarded to Mr. G. A. Ure, of Bonnybridge, for an extremely ingenious improved picture-hanger. Like all the best ideas, this one was extremely simple. Mr. Ure, unless I am making a serious mistake, is the managing director of Smith & Wellstood, of Bonnybridge, and is well known in foundry circles.

* * *

Talking of inventions reminds me of patents, and patents in their turn remind me of a remark I heard in Germany to the effect that a native of that country finds far greater difficulty in taking out a patent there than does a foreigner. Somewhat similar conditions are popularly supposed to prevail over here, and however obscure the reason, it is consoling to learn that it operates internationally. These things are never so trying if they are reciprocal!

* * *

Recipes for longevity are as a rule so gloomy in character that most of us have decided a long while ago to choose a short life and a merry one! No drinking, no smoking, twelve hours' sleep every night, a diet consisting of underdone spinach, or of hard-boiled eggs, or of rye-bread —these are among the methods that have been recommended to us from time to time. It was therefore with real relief that I read the other day of Mr. John Sands, formerly a native of Burwash, in Sussex, who recently died at the advanced age of one hundred and three years and five months. I quote from my authority. "He was a great smoker, believed in plenty of hard work, plenty of beer, and the eating of fat pork, as a specific for a long life." On the principle that the best dramatic critic is a man who writes good plays, I think we may consider Mr. John Sands to have been something of an authority on the subject. So there's hope for you all. Whoever heard of a founder who neither drank nor smoked—nor worked hard?

Of course, the bit about hard work is the fly in that particular ointment, but after all, how many of us have any choice?

* * *

Next time you are called upon to make an impromptu speech, remember the Irishman who fell down a deep ditch, and assured his mates when they fished him out that he was still alive, "But," he added, "I'm spacheless!"

Marksman.

High-Test Grey Cast Iron.

The good strength properties of grey cast iron containing below 3.0 per cent. of carbon must be attributed for the most part to the finely-divided form of the graphite, and this form is generally considered to be the consequence of the low carbon content. But irons containing about 3.0 per cent. of carbon and over show also, as K. Emmel states,* a very fine distribution of the graphite together with excellent mechanical properties, when they are made in the cupola at high temperatures with the addition of steel scrap. These irons pour much better than low-carbon irons, and they can be handled in the same way as standard cylinder iron. Because of the high temperature they can stand for a long time and be hand-shanked without becoming dull. The silicon content can be almost as high as in low-carbon irons without unfavourably affecting the fineness of the graphite and the strength properties, as can be seen from Fig. 1 and Table I. Therefore very thin sections can be cast showing good machinability.

The percentage of the total carbon is controlled by the design and working of the cupola and the quality of the coke. The quantity of steel scrap added seems to have little influence. It was found that with 50 per cent. of steel the carbon could be kept between 2.9 to 3.1 per cent., and with 60 to 70 per cent. of steel between 3.1 to 3.4 per cent. With the increasing silicon content the carbon content decreases. Experiments with a cupola with receiver showed that it was impossible to keep the carbon below 3.0 per cent. when the quantity of steel was 60 per cent. and the silicon content 1.0 per cent. But this was readily brought about with 50 per cent. of steel scrap and 1.8 per cent. and more of silicon. The relationship between the two components is illustrated by the diagram given in Fig. 2. With the cupola without receiver the effect of the silicon seems to be not so pronounced; but here the experiments are not yet concluded. Manganese seems to have the opposite effect on the carbon content, as the average carbon content of 33 heats was 2.85 per cent., with 0.7 per cent. of manganese, whereas, with 116 other heats, it was 3.0 per cent. with 1.0 per cent. of manganese. But this fact is not yet conclusive, because in these experiments, as the author states, the quality of the coke was not always the same.

Table I.

Heat No.	Chemical composition. Per cent. C.	Si.	Mn.	S.	P.	Transverse strength. T./sq.in.	Diameter of bar (as cast). In.	Tensile strength. T./sq. in.
1	2.99	2.45	1.27	0.074	0.15	36.5 39.9	0.787	20.5 22.5
2	3.03	1.89	1.10	0.090	0.16	32.9 32.3 33.1	1.182	18.4 18.5 18.5
3	3.04	2.07	1.17	0.115	0.09	33.8 35.2	1.182	19.4 18.8
4	3.05	1.37	0.41	0.187	0.12	37.3 36.2 36.0	1.182	—
5	3.05	1.96	0.69	0.090	0.20	32.7 33.1 33.1	0.787	—
6	3.06	1.88	0.89	0.129	0.16	34.2 38.0 41.0	1.182	—
7	3.10	1.41	0.62	0.153	0.12	38.3 36.6 37.6	1.182	19.4 19.2 21.1
8	3.14	1.63	0.73	0.100	0.24	31.1 33.2 31.4	0.787	19.7 19.4
9	3.15	1.66	0.82	0.122	0.20	30.1 31.7 29.8	1.182	19.9 18.7 18.7
10	3.16	1.35	0.86	0.120	0.30	34.6 36.3 35.8	0.787	20.7 20.3
11	3.26	1.92	0.94	0.108	0.26	30.0 30.0 32.6	0.787	19.6 19.8 19.3
12	3.28	1.85	1.02	0.114	0.19	33.8 34.4 32.9	0.787	18.9 19.2 19.0
13	3.31	1.64	0.80	0.108	0.24	34.4 31.9 35.2	0.787	18.4 19.1
14	3.38	1.00	0.83	0.118	0.27	32.1 34.7 34.3	1.182	18.5 18.3
15	3.40	1.25	1.05	0.116	0.26	36.9 40.9 37.6	0.787	19.9 19.9 20.3
16	3.47	1.19	0.97	0.106	0.26	34.4 36.0 33.4	1.182	19.4 19.0
17	3.47	1.61	0.98	0.110	0.26	34.4 33.1 32·6	0.787	19.3 17.9
18	3.48	1.41	0.98	0.124	0.43	32.8 30.3 30.9	0.787	17.4 17.0 17.1
19	3.53	1.59	1.00	0.118	0.34	35.3 31.9	0.787	18.4 19.2

The sulphur content increases with the increasing quantity of steel added; with 70 per cent. of steel sulphur contents of up to 0.156 per cent. were obtained.

As to the possibility of reproducing results in the foundry, the author gives four tables in which the compositions of the heats during a certain period are recorded; thereby no heat was omitted. One of these tables is reproduced in the diagram shown in Fig. 3. It can be seen that the average carbon content of 116 heats was 2.95 per cent. (the extreme values being 2.77 and 3.21 per cent. respectively). The average strength properties were: tensile strength, 18.9

Fig. 1.—× 50. T.C., 3.22; Si, 2.09; Mn, 0.92; S, 0.089 and P, 0.20 per cent.

t./sq. in.; transverse strength, 34.0 t./sq. in., and deflection, 0.437 in. The tensile test bars were cast on and machined to a diameter of 0.394 in. and a length of 4.33 in. The standard transverse test bars were cast separately, and had a diameter of 1.18 in.; they were tested in the as cast condition at 23.6 in. centres.

As to the hardness of an iron containing about 3.0 per cent. of carbon, it was found that with bends cast in green-sand moulds it varied very little with the wall thickness, being 183 to 188 Brinell units in the pipe wall (0.55 in. thick)

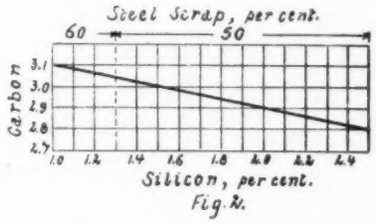

Fig. 2.

and 177 Brinell units in the flange (1.38 in. thick), though the silicon contents of the various castings were from 1.33 to 2.10 per cent., and the strength properties changed accordingly. The fluidity of such an iron containing only 0.15 to 0.20 per cent. of phosphorus can be seen from the fact that pressure pipes 78.7 in. long and 0.51 in. thick, with an inside diameter of 12.15 in., could be cast from one end only, gates and risers being of normal sizes. These pipes withstood a water pressure of 661 lbs./sq. in. without leaking or breaking. Furthermore, with an iron containing only 0.4 per cent. of phosphorus ribbed pipes were cast showing a tensile strength of up to 19.7 t./sq. in. A special feature of the iron containing about 3.0 per cent. of carbon is that it shows little tendency towards piping. This was demonstrated by casting a cylinder with a wall thickness of 0.866 in., having side-bosses of 3.94 in. dia.; no risers were used; after

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* "Die Giesserei," 1929, No. 27.

breaking no pipes could be detected in the critical sections.

An iron containing over 3.0 per cent. of carbon will be best used in cases where softness and toughness are required. With such an iron deflections of up to 5.9 in. can be obtained. The experiments hitherto made do not yet permit, as the author states, to give a complete characteristic of the iron with more than 3.0 per cent. of carbon, but tensile strengths of up to 20.3 tons per sq. in. and transverse strengths of up to 38.1 tons per sq. in. were obtained.

Finally the author compares the results in question to that obtained some years ago, and he finds that the possibility of reproducing results in practical working has increased more than twofold.

Contracts Open.

Bradford.—Bolts, nuts, screws, nails, iron, malleable iron and steel castings, phosphor bronze, gunmetal and brass castings, insulated bolts, strains and copper controller contacts, and iron and steel bars, for the Tramways Committee. Mr. R. H. Wilkinson, general manager, 11, Forster Square, Bradford.

Cairo, November 25.—Two Diesel pumping units and accessories, for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference A.X. 8,619.)

Larne, November 13.—2,420 yds. of 4-in. cast-iron water pipes, and 816 yds. of 9-in. and 6-in. cast-iron sewerage pipes, for the Larne Rural District Council. Mr. S. Robinson, engineer, Victoria Street, Larne.

Newton Abbot.—10 tons of 6-in. and 10 tons of 9-in. cast-iron pipes, for the Newton Abbot Rural District Council. Mr. S. Olver, highway surveyor, 38, Keyberry Park, Newton Abbot.

The Formation of the Eutectic Graphite.

W. Heike and G. May studied the influence of the chemical composition and the cooling rate upon the formation of the eutectic graphite.* Swedish grey charcoal iron was melted in the Tammann furnace at 1,350 deg. C.; after having been alloyed with ferro-silicon and ferro-manganese the iron was cooled in different ways: in the furnace, in the air, in green-sand moulds, and in chill moulds of different sizes.

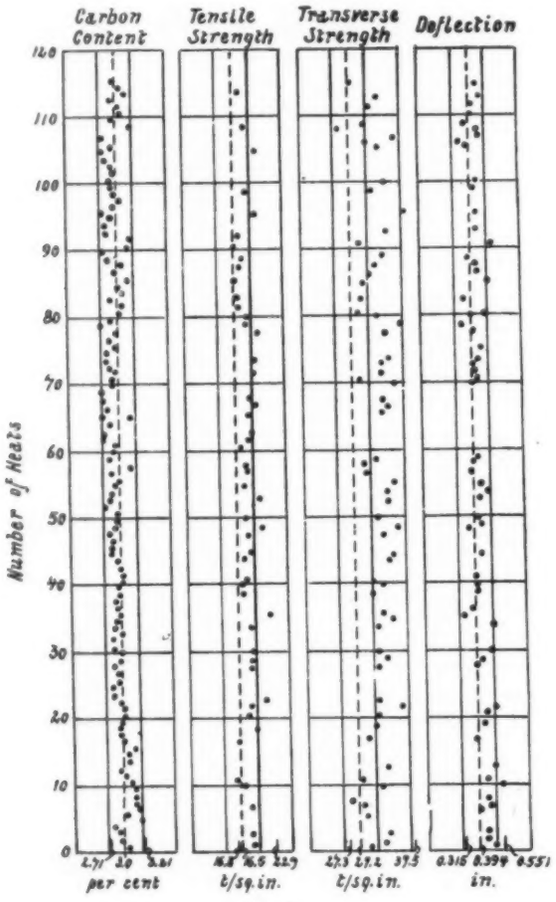

Fig. 3.

From the experimental results the authors draw the conclusion that the formation of the eutectic graphite is favoured by low silicon and carbon contents, and by rapid cooling. These three factors must be so regulated that the iron has a tendency to solidify cardic, yet will show a grey structure.

As to the matrix it was found that the eutectic graphite is embedded in ferrite or in pearlite. The ferrite (which the authors call ferrite I) is formed at a more rapid cooling than the pearlite. This was demonstrated by a sample containing 2.63 per cent. of carbon, 3.0 per cent. of silicon, and 0.8 per cent. of manganese, and which was cast on a steel sheet. A section of this sample is shown in Fig. 1. Besides the cooling rate high silicon and low carbon contents favour the formation of ferrite I. From this ferrite there must be distinguished the ferrite (II), which forms at a very low cooling rate, and which always contains coarse graphite.

In several samples long needles of cementite could be seen extending from the white into the grey eutectic area, and being in the state of decomposition. From this the authors conclude that the eutectic graphite may be a secondary product of the cementite which at first changes into a solid solution. The reactions thereby taking place are:

$$Fe_3C \quad — \quad 3Fe + C.$$

Fe_3C (undecomposed) + Fe — mixed crystals. There could also be seen long rows of mixed crystals, which in the white area showed a pearlitic structure, whereas in the grey zone they were ferritic. Furthermore, it was observed that pearlite is always the first product of the decomposed cementite. Therefore the ferrite I is also a secondary product, and the eutectic-like grey structure obtained in rapidly-cooled samples cannot be identified with the ferrite-graphite eutectic of the stable iron-carbon system.

Some samples containing 3.5 per cent. of carbon and from 2.5 to 4.0 per cent. of silicon, which cooled in green sand moulds, showed three

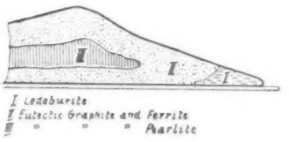

Fig. 1.

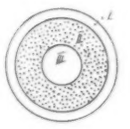

Fig. 2.

distinct areas of different structures, as is illustrated in Fig. 2. Area I contained eutectic graphite and ferrite, area II coarser graphite and pearlite, and area III eutectic graphite and ferrite. The structure of the areas I and II can be explained by the cooling rate, which in area I was higher than in area II. For the formation of the structure in area III some other factor must be responsible; this is the pressure exerted by the solidifying areas I and II upon the still liquid interior. As the formation of the graphite is associated with an increase in volume the pressure favours the formation of white iron. Thus at a definite chemical composition and a definite cooling rate the solidification will take place at the limit of the stable and the metastable system, a condition which is favourable for the formation of the eutectic-like graphite.

* "Die Giesserei," 1929, Nos. 28 and 29.

German United Steel Works Corporation.

The report of the Vereinigte Stahlwerks A.-G. for the complete financial year ended with September 30 last, has just been issued. The report shows that the total production of coal increased from 26,454,510 tons in 1927-28 to 27,241,990 tons in the financial year just ended, and that of coke from 9,414,848 tons to 9,604,032 tons. On the other hand, the make of pig-iron declined from 6,518,682 tons in 1927-28 to 6,007,739 tons, and that of steel from 6,945,186 tons to 6,419,796 tons. The number of workmen employed by the company rose from 172,595 in 1927-28 to 176,716 in the past year, and of these the coal miners, etc., represented 82,404 and 87,085 in the two years, respectively. The figures for the salaried staff were 15,394 and 15,331 in the two years, those engaged in the coal branch having numbered 4,988 and 4,948, respectively.

The turnover is stated to have declined from the definite figure of 1,437,687,092 mks. in 1927-28 to 1,433,358,000 mks., the provisional estimate for the past year. As regards the home and foreign trade, the report states that 958,101,560 mks. were from inland customers in 1927-28, as against 904,320,000 mks. in 1928-29, and 479,585,532 mks. and 529,038,000 mks., respectively, from export customers. The above figures, of course, do not include transactions between the individual departments of the company nor the sales to undertakings in which the company has an interest. It is added that the stock of orders for iron and steel on the books of the ironworks and finishing plants on September 30, 1929, represented about 81.9 per cent. of the monthly average in 1927-28.

Science Hand in Hand with Labour.*

By Frank Hudson.†

During the last decades the foundry trade has witnessed a wonderful progress in knowledge and many new discoveries. Practices which seemed impracticable to our forefathers have become standard to our business methods of to-day. The seemingly absurd suggestions of to-day will, no doubt, furnish the practical methods of to-morrow. What has been the success of this progress? Is it the thoughts of the scientist and metallurgist, or the work of the practical man? Surely neither can rightly claim the credit. The foundry trade can be likened to a monster machine supplied with *power from capital*, constructed and driven by the *cog-wheels of the practical man*, and supplied with *scientific oil by the metallurgist*. All have a part to play, and it does not matter whether the machine is large and composed of many fast-moving parts, representing the large and mechanicalised production foundries of to-day, or whether it is formed by the smaller and slow-moving parts of the foundries of yesterday. Without capital power the works cease to revolve. Without practical cogwheels the works come to a standstill. Without suitable scientific oil the machinery must be run at a lower speed. Furthermore, the right kind of scientific oil must be furnished to the practical cog-wheels to obtain the least friction with the fastest speeds. For the continued progress of the industry, *science must work hand in hand with labour*, and it is the intention of this Paper to bring forward in a practical manner those scientific applications of most benefit to general foundry practice, which are apt to be overlooked by the practical man, and to create a discussion for the advancement of this question.

It is not the intention to treat with any patented improvement or process, but rather to select applications of international interest, which can readily be applied in almost any foundry. At the same time it should be understood that the scope of the Paper is a large one, and if anyone considers that certain scientific applications have been omitted then the value of the discussion would be certainly improved by their mention. For convenience only those points relative to grey iron founding will be dealt with, especially applicable to foundries producing high-duty castings, and castings subject to pressure. The Paper is divided into two parts, one section considering the helpful scientific applications that can be applied relative to the melting and composition of grey cast iron, whilst the other part treats with the moulding and core-making side.

TABLE I.—*Grey Cast-Iron Mixture Specifications.*

Mixture No.	Analysis. T.C.	Si.	Mn.	S.	P.	Types of castings.
I ..	3.5*	1.8 to 2.1	1	0.09†	0.2 to 0.4	*Ordinary Metal.*—For low and medium-pressure castings made in green sand not over 1-in. section, low-pressure castings in dry sand up to 1-in. section, structural work up to 1½ in. thick, and general castings with no test specified. *Typical Applications.*—Pipes, light sluice-valve bodies up to 24 in., medium valve bodies up to 10 in., heavy valve bodies up to 6 in., extra heavy valve bodies up to 5 in., general machinery castings, condenser and turbine castings, automobile cylinders, light and medium bed plates, etc.
II ..	3.3*	1.5 to 1.8	1	0.09†	0.2 to 0.4	*Soft Semi-Steel.*—For low and medium-pressure castings made in green sand between 1-in. to 1½-in. section, low and medium-pressure castings made in dry sand up to 1½-in. section, heavy structural work, and low-pressure castings up to 2 in. thick. *Typical Applications.*—Heavy bed-plates or sole-plates, light sluice-valve bodies above 24 in., medium valve bodies above 10 in., heavy valve bodies above 6 in., extra heavy valve bodies above 5 in., hydraulic pipes, low and intermediate marine engine cylinders, etc.
III ..	3.0*	1 to 1.2	1	0.10†	0.2†	*Semi-Steel.*—For high-pressure castings over 1½ in. thick.
IIIA ..	3.5*	1 to 1.2	1	0.10†	0.2†	*Typical Applications.*—Hydraulic rams and cylinders not over 3-in. section, hydraulic valves, steam and pump cylinders, locomotive cylinders, high-pressure valves over 2-in. section. Reciprocating or bearing engine parts in metal-to-metal contact. For cylinder work having unequal sections use mixture No. IIIA.
IV ..	3.0*	0.6 to 1	1	0.10†	0.2†	*Hard Semi-Steel.*—For hard-wearing castings, heat-resisting work, and exceptionally thick high-pressure work. *Typical Applications.*—Hydraulic rams and cylinders over 3-in. wall thickness, heat-resisting gas, reversing valve tongues, ingot moulds, bearing sleeves and races, castings for handling ammonia at high pressures.

* Approximate. † Maximum.

NOTE.—If castings are authorised to be cast with metal other than stated here, raise a query.

Melting and Composition of Grey Cast Iron.

The first essential for the successful production of grey-iron castings is to decide upon the analysis of the iron mixture most suited to the castings being produced. This statement is not sufficiently appreciated by the practical man, who generally is only familiar with his two mixtures of hard and soft, special and common, or some such other terminology. These may mean anything. For example, his hard mixture, assuming it is semi-steel, could easily range from 1.0 to 2.0 per cent. silicon, or contain from 5 to 90 per cent. of steel scrap. The term semi-steel in itself covers a multitude of sins, and admits of little co-ordination, and there is an international need to-day for a term which will express or give some indication of the grade of semi-steel most suited for different classes of work. It has been suggested by the technical Press of Britain that the term "steel-mix iron" would be preferable, giving the percentage of steel in the mixture as a prefix—for example, "20 per cent. steel-mix iron," etc. This is certainly a suggestion worthy of further consideration, as it will help to educate the practical foundryman into the ways of the metallurgist, and the means of intelligently expressing scientific suggestions into practice.

To-day many foundries have as many as six mixtures going through the cupola in one day's blow, and it can be safely said that the composition of the casting extensively determines its quality, freedom from defects, and future service. Considerable variation exists in the composition of the same castings from different foundries according to the accepted views and technical knowledge on hand. In the author's own experience the composition specifications shown in Table I have always been accepted as a standard, and have proved their practical worth time and again, and are typical of the best practice.

Quality.

The quality of grey-iron castings is generally determined by their appearance as cast, and after machining, and by the test results of the inspector's bars. This question of quality representation by test-bars has given rise to a great deal of thought in the last few years in order to try and correlate strength with mass effect, and so obtain a better idea of the actual strength obtainable in different sections of castings. This is a most important point to the designer. The British Engineering Standards Association, in co-operation with the Cast Iron Research Association and the Institute of British Foundrymen, have recently issued a new Specification[1] which is intended to further this matter, and suggests the use of round bars of varying section according to the section of the casting being made. This is a step in the right direction, but at the same time such a specification demands of the founder a more intimate knowledge of those technical points in the composition of cast iron which give quality and good test-figures. The specification shown in Table I has been drawn up with this fact in mind, and it has been found that cast iron, having the analysis as stated, will give the specified test-figures. For example, a casting ½ in. thick cast in dry sand with mixture No. 1 will give approximately 11 tons per sq. in. tensile, whilst a large

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* Extracted from a Paper presented on behalf of the Institute of British Foundrymen to the American Foundrymen's Association.

† The author is now head of the newly-established research department of Messrs. Fordath Engineering Company, Limited, West Bromwich.

hydraulic cylinder 4 in. thick cast in No. 4 mixture will likewise give 11 tons per sq. in. tensile, these results being obtained from test-bars of varying sizes to meet the difference in casting section.

Besides bearing upon quality, the composition of the iron has an important part to play in obtaining castings free from defects. In this connection the defect most troublesome to the average founder is that of shrink-holes. This is of particular import when castings are subject to a pressure test, and in this respect the specification shown in Table I has been instituted through research, and the composition of the irons shown therein found to exhibit the minimum of trouble to this cause.

Solidity.

The solidity of grey-iron castings is determined by several factors, such as metal composition, pouring temperature, method of moulding, design, etc., and of these composition has an important part to play. Especially is this the case when badly-designed jobs are on hand, and it is peculiar that the more important castings such as locomotive cylinders and valve bodies, etc., are the biggest offenders in this respect. When a casting leaks under test, and the practical man has his suspicions of the presence of porosity and shrink-holes, he either thinks the metal is too hard, or else decides

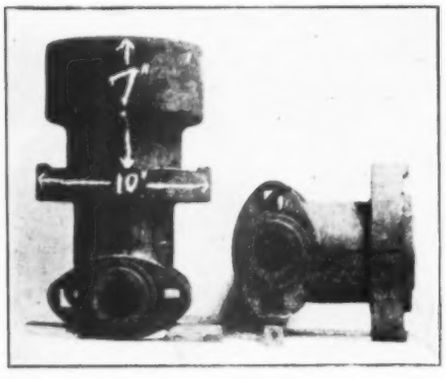


Fig. 1.—Weight of Casting, 2 qrs. 14 lbs.; Weight of Head, 2 qrs. 11 lbs.; Head, 95.7 per cent. Weight of Casting.

to put a riser on that spot, or some sort of feeding head. By softening the metal it is highly probable that matters are made worse, whilst by the inclusion of extra heads and risers up goes the weight of metal required for the job, and the ratio of castings produced to material melted is not so good, and all this helps to keep up high "oncost" or "overhead charges." Iron with a suitable composition helps economic working. A concrete example came to the authors attention recently as shown in Fig. 1, which shows a 2-in. hydraulic stop-valve body for 2,500 lbs. per sq. in. test pressure. Valve A was the general method used for moulding, employing a large feeding head and casting vertical with soft iron, of the following composition:—T.C., 3.30; Si, 2.00; Mn, 0.70; S, 0.075 and P, 0.60 per cent. Without the feeding head, trouble invariably occurred due to leakage on test. By altering the composition to a semi-steel mixture, similar to mixture No. 2 in Table No. I, and casting on the side as shown at B, Fig. 1, it was found that the head could be dispensed with, and the resulting casting was perfectly tight on test and possessed a very much superior appearance after machining. This enabled a large saving to be made in machining time, whilst the removal of the head, which was 95.7 per cent. weight of the casting, resulted in a saving of metal and increased production. In Fig. 2 is illustrated a similar saving on a larger casting through the use of correct composition. Another example came to light in the casting of locomotive cylinders. These cylinders were a constant source of trouble due to weepage under test in the piston-valve steam-ports. The cause was unquestionably due to porosity and the presence of shrink-holes through unequal sectioned metal. The obvious practical solution was the use of chills or denseners, and at one time numerous chills were in use on a single cylinder. This certainly improved matters but did not entirely cure. The average composition in use was T.C., 3.3; Si, 1.2; Mn, 0.70; S, 0.08 and P, 0.42 per cent. This was modified to T.C., 3.53; Si, 1.0; Mn, 1.0; S, 0.08 and P, 0.12 per cent., and sound cylinders were obtained without the use of a single chill. It will be noticed that particular mention is made of this iron in Table I as mixture No. 3A. The average hardness of this composition runs around 212 Brinell and 18 tons per sq. in. tensile was regularly obtained. These are not isolated cases of individual experience, but other instances can be cited, selected from the various technical proceedings and transactions. For instance, Smalley[2] gives examples of obtaining greater solidity in sluice valves, and the displacement of chills on unequalled-sectioned metal at the valve faces, by a revision of composition. The reason for obtaining sounder castings by the use of correctly-compositioned mixtures is explained by the work of Smalley, McKenzie, Bolton[2] and others, and it is very desirable that their writings upon this subject should receive greater attention. In fact, an extensive practical application of such work would do far more good to the general foundry trade than many other scientific researches published in the last few years.

The bibliography included at the end of this Paper should be used for reference by all interested in this question, as the information is such as to be quite understandable by the bulk of practical workers. However, it can be stated that all shrink-holes and porosity are formed during the freezing or setting period of the molten iron in the casting, and the composition determines the length of this period. The softer the iron, the greater the freezing period, and the harder the iron becomes then the less is the freezing period. It is obvious that the smaller this range then the likelihood of porous castings being produced is corresponding reduced. Of course, it should be clearly understood that casting temperature, type of mould used, moulding methods and cupola operation are all bound together for success in this matter, and these will receive consideration later. By reducing the total carbon, silicon, phosphorus and manganese, and by increasing the sulphur, an iron with the lowest freezing period is obtained. This, however, would not be good practice used indiscriminately, as trouble would certainly arise due to lack of fluidity and hard castings produced. The bulk of the information on hand relative to this question suggests that the manganese and sulphur should be constant around 1.0 per cent. Mn, with the sulphur not exceeding 0.10 per cent. and the necessary variations made in the other elements. In the author's experience it has been found that for high-class work the total-carbon content should not drop below 3.0 per cent, and for cylinder work, having variation in section, an increased amount of total carbon up to 3.5 per cent. is desirable. The present-day tendency for total-carbon contents below 3.0 per cent. is not essential for general foundry practice and leads to difficulties. The important part the total carbon plays in the solidity of castings is unquestionably hinged upon the cooling rate and casting section. With the same cooling rate and casting section an increase in the total-carbon content brings about "liquid expansion," which in conjunction with a composition of short freezing range is an invaluable help for obtaining solid castings having varying section in their design. However, the use of high total-carbon mixtures and the consequent increase in graphitic carbon demands that low-phosphorus content be used to obtain satisfactory toughness and good test results.

Fluidity.

The fluidity of the compositions shown in Table I are perfectly satisfactory, providing they be used for the sections stated and consistent with good cupola practice. It is thus obvious that in drawing up this table an attempt has been made to correlate composition with casting quality, as determined by strength and solidity, in order to provide a suitable working basis for the foundryman. At the same time, it is quite probable that the grade of material used to obtain the mixture, such as quality of pig-iron, percentage of scrap, etc., will cause different results to be obtained even in cast iron of similar analysis. This point will be considered under the next paragraph on the melting of grey cast iron.

Melting of Grey Cast Iron.

Unless careful and consistent cupola operation is practised, the values accruing from composition specifications are negligible. The melting of cast iron has been very badly neglected in the past, and very little real general practical progress has been made. New developments from time to time have been brought out which tend to perfect the working of the cupola. These should be very carefully considered before adoption, as a great number are old facts in disguise, and the foundryman could have easily

Fig. 2.—Weight of Casting, 4 cwts. 1 qr. 2 lbs.; Weight of Head, 1 cwt. Head, 23.4 per cent. Weight of Casting.

applied them himself if he had tried to study the working and changes taking place within the furnace. Other improvements, however, are well worth installing. The cupola, as a furnace which nowadays has to be controlled to give definite results, is certainly a difficult proposition, yet when run under scientific lines gives wonderful uniformity for general foundry practice. Cupolas are too often left to be managed by men who, through lack of sufficient knowledge, dare not deviate from their present practice. The essentials to be looked for in good cupola practice may be stated as follow:—(1) Careful weighing of all pig-iron, coke, etc., including air; (2) careful analysis in conjunction with physical tests of all raw materials used; (3) correct fluxing; (4) rapid and hot melting. The molten iron should leave the furnace spout having a temperature of at least 1,400 deg. C. The hotter the better; (5) the brickwork at the charging-door should never exceed black or dull-red heat until the last 30 minutes of blow, and (6) correct flame at the charging-door. A bluish-pink flame, clinging to every little projection and ledge in the chimney-stack, now and again running down and burning at an opening in the charges.

Mechanical charging is equally as good as hand charging, and saves the double handling necessary for hand-charged cupolas after the weighing operation. The system in use by the author is shown in Fig. 3, and has proved perfectly satisfactory.

Blast Control.

Blast control is a vital factor, and it is essential for successful control. Fig. 4 illustrates a typical pressure and volume meter, and the limit marks on the volume-indicating tube should be particularly noted. These are set by the laboratory according to the best practice, and the cupola controlled by the furnaceman to give a constant figure. Constant blast pressure and volume is most important in cupola working, as this is the absolute index of a constant melting zone. In this respect another point which is often overlooked is that the melting zone is fixed by the tendency of the air to travel upwards. Any disturbing factor, such as a large open slag-hole, will lower the melting zone, and possibly give dull metal. The slag-hole in cupola working should only be opened when essential, and then closed as soon as possible, or, on the other hand, kept open altogether. Some years ago the author conducted a research[3] upon the melting and casting of high-duty irons, and an investigation into the changes taking place inside the cupola, and obtained the conclusions that three distinct zones existed in which the following changes occurred:—

Zone 1.—*Extending from the charging door sill down to beginning of melting zone.* For practical purposes cast iron and steel mixtures in this zone absorb no extra carbon until actual melting begins.

Zone 2, *or the actual melting zone.*—Cast iron and steel melt just above the hottest zone at their respective melting temperatures, and fall through the hottest zone in small drops, this zone having a temperature of at least 1,650 deg. C., which is amply sufficient to superheat these small drops. Carbon absorption now takes place very rapidly, due to high temperature and intimate contact with incandescent coke. The degree of carbon absorption depends upon the prevailing atmosphere in the melting zone and the composition of the material being melted, together with time and temperature in the melting zone. The higher the temperature the more carbon will tend to be absorbed in a certain time, according to the facility of applying free carbon and the reactivity of the coke structure. The absorption is lowered by excessive blast, with the consequent production of an oxidising atmosphere, and material containing a low-carbon content such as wrought iron or steel will probably not pick up as much carbon as cast iron. All cast-iron material is superheated in the true sense of the term superheat, whilst wrought iron and steel are not superheated in the true sense of the word, but by melting at a high temperature and solidifying at a much lower temperature obtain a superheat greater than the cast-iron material.

Zone 3.—*Extending from the melting zone to the well.* The molten metal lying in the hearth or well falls in temperature, and in the case of cast-iron material probably loses carbon. Steel charges may, however, still absorb further carbon according to the degree of carbon absorption obtained when passing through the melting zone. Sulphur is absorbed in the last two zones.

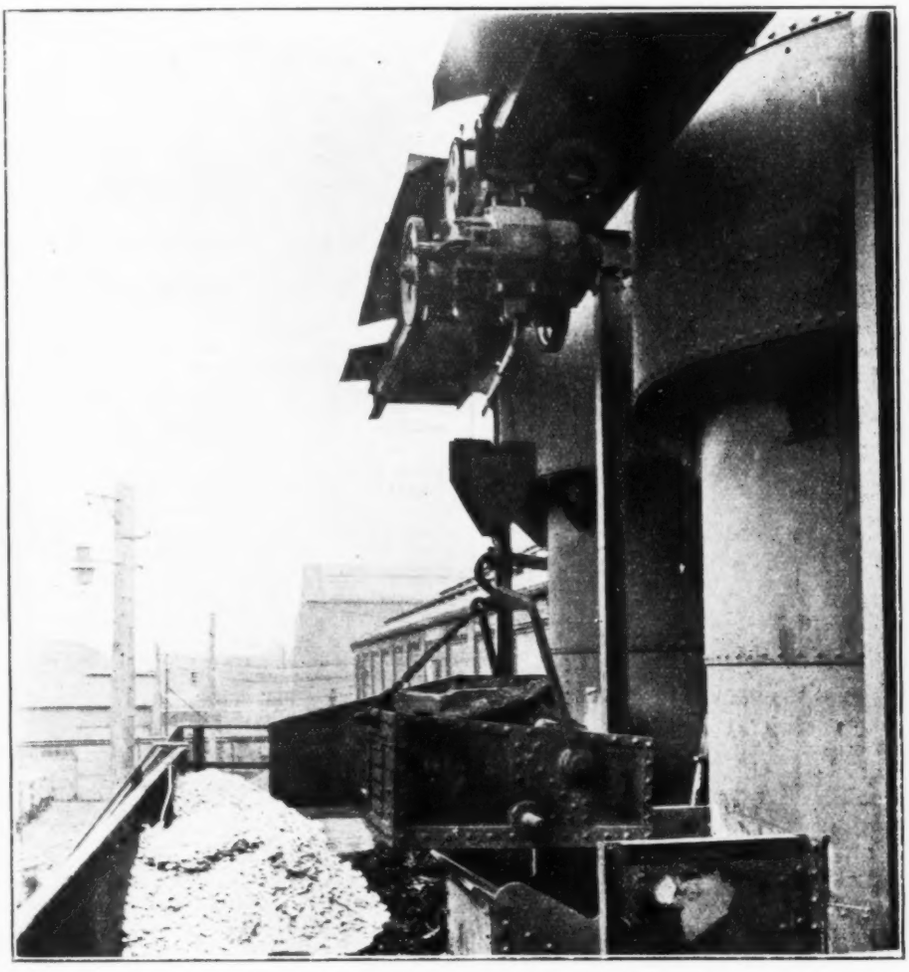


Fig. 3.—Mechanical Cupola-Charging System.

Total-Carbon Control.

At the present time total-carbon control in the iron foundry is a very difficult matter, and likely to become of extreme future importance in the development of high-test material either through the use of alloy additions or by modified melting practice. The original carbon content of the material being melted has very little bearing upon the final-carbon content after melting, and it can unquestionably be stated that cupola control is the key to this matter. For general high-duty castings using varying quantities of steel in the mixture, and giving a minimum of 3.0 per cent. total carbon after melting, the aim should be to have the correct amount of air to combine with the coke to give a neutral or very slightly oxidising atmosphere. The lower the blast pressure, consistent with correct volume, then the hotter is the metal obtained, due to a lower melting-zone and hotter hearth. For high total-carbons melt hot, but slowly. The melting point of the materials used has quite an appreciable effect upon the resulting temperature obtained, and in the author's opinion this point has quite a bearing upon the preference for sand-cast instead of machine-cast pig. It is suggested that the combined carbon figure determines the actual melting point. In conjunction with the need of cupola control for obtaining the correct total-carbon contents, the important part played by the coke must not be forgotten. McKenzie[4] has shown that different degrees of carburisation can be obtained according to the structure and physical properties exhibited by the coke used for melting, and this is further accentuated in the Corsalli process used for obtaining high-test cast irons where the reactivity of the coke is diminished by immersion in a lime sludge, and an oxidising atmosphere obtained during melting by increased blast. This produces extremely low total carbons. In the melting of cast iron to be used for quality castings the following points should be remembered:—(1) The bed coke should be measured by volume, and the charged coke by weight; (2) the metal mixture should be of uniform size. Too small and thin bulky material produces oxidised metal, whilst large thick sections produce cold metal; (3) every care should be taken to keep a constant melting zone, influenced by the presence and volume of blast used; (4) proper fluxing, using a slightly basis slag, together with hot melting, will keep the sulphur low. (This can be obtained by the use of a small amount of manganese ore with the limestone); (5) careful attention to the small points, and (6) hot melting is essential for good work.

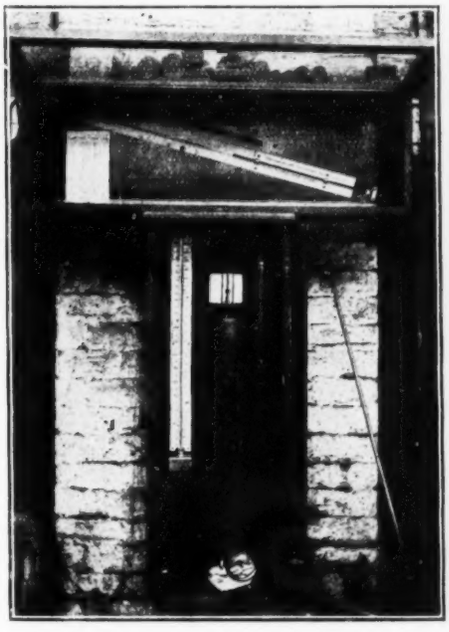


Fig. 4.—Pressure and Volume Meter.

Choosing a Mixture.

This section would not be complete without reference to the suitability of different mixtures

and brands of pig-iron for grey-iron castings. The author prefers to use a synthetic cold-blast iron, containing at least 10 per cent. steel scrap, made in a cupola or open-hearth furnace. This is remelted with silicious hematite (5 per cent. Si) and a slight percentage of steel and domestic scrap added for cylinder work. In all pressure castings with variation in section over 15 per cent. of steel scrap is never added directly to the mixture without remelting, although the final mixture may actually contain well over 50 per cent. steel scrap in the remelted condition. This is usually done to obtain a total-carbon content of approximately 3.5 per cent., as low total-carbon iron is not recommended for work other than perfectly uniform sections.

Table II illustrates a specimen daily cupola record, showing the control that should always be the practice in progressive foundries. In the author's own works this system has resulted in a saving of between 2 to 3 per cent. in defective work.

Table II.

DAILY CUPOLA REPORT.

GLENFIELD & KENNEDY LIMITED, KILMARNOCK.

Date 21. Aug. 28. Blast on 10.30 A.M. Bottom Dropped 5.0 P.M.

Cupola No. A.

No. of Charges	Mixture — Material	Tons	Cwts	Qrs	Lbs	Calculated Analysis Si	P	Actual Analysis Tc	Si	Mn	P	S	Wt. of Charge Cwts	Wt. of Coke Lbs	Wt. of Limest Lbs	Blast Press	Vol	Remarks
1/2	SCRAP	-	15	-	-	2.2.40							30	334	100	18"	5333 cu.ft. per min.	Run off metal
1	HEMATITE	-	7	2	-													
	SCOTCH No.3	-	7	2	-	2.0.40							"	"	"			Mixture No.1.
	SCRAP	-	15	-	-													
6½	HEMATITE	-	7	-	-													
	SCOTCH No.4	-	8	-	-	1.5.30							"	"	"	10"		Mixture No.2.
	STEEL	-	7	-	-													
	SEMI-STEEL SCRAP	8	-	-														
30	HEMATITE	-	7	2	-			2.02	.85	.21	.073					10"		Mixture No.1.
	SCOTCH No.3	-	7	2	-	2.0.40		2.02	.80	.29	.079		"	"	"	To		
	SCRAP	-	15	-	-			206	.82	.25	.069					14"		
								1.97	.77	.45	.073							
	KEEP'S SHRINKAGE TEST = .142" per foot.																	
	TRANSVERSE TEST 1" x 2" bar on 3ft. centres = 31 Cwt. 0 Qrs. 8 Lbs. with .529" defl.																	
	MATERIAL ANALYSIS																	
	HEMATITE							4.02	2.14	0.5	.06							
	SCOTCH No.3							3.4	2.41	0.5	0.06							
	SCOTCH No.4							3.5	1.7	1.2	0.06							
	SCRAP							3.3	2.0	.90	.40	.08						

MELTING RATE 9.1 Tons per hour.
TEMPERATURE AT SPOUT = 1400° C (OPTICAL)

Weight of Bed Coke 1 - 2 - 3 - 0
Total Iron Melted 57 - 0 - 0 - 0
Total Coke Used 5 -13 - 1 - 8
Total Limestone Used 1 -13 - 3 -20
Coke Ratio to Iron Melted 1 -10 - 0

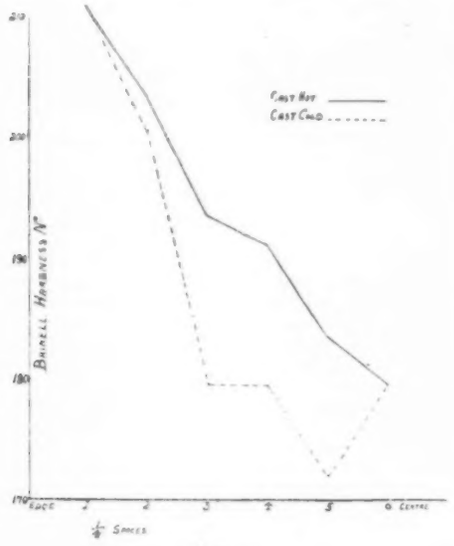


Fig. 5.

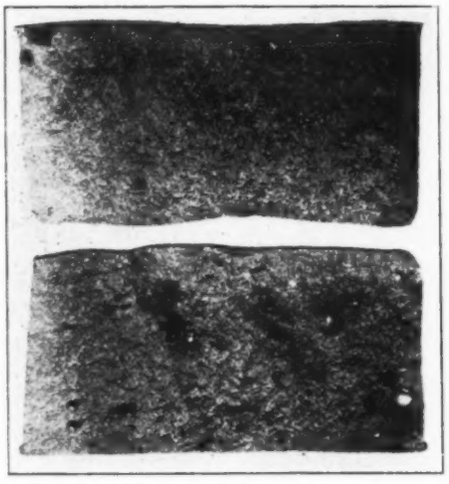


Fig. 6.—The Top Cast Hot and Bottom Cast Cold.

Pouring Practice.

All high-duty work should be poured hot. Pouring hot is essential, whether the casting be large or small, thick or thin, if the best work is to be turned out. Lack of density in castings is due to casting at too low a temperature. This lack of density is due to either blow or shrink-holes. In large castings foundrymen, as a rule, have often a certain fear of casting hot. That this is a fallacy was brought home in the author's experience some time ago. A Diesel-engine flywheel, of about 12 tons weight and 36 in. section, had been cast on the cold side and was badly drawn under the risers. Prior to this, one had been cast very successfully at a higher temperature. The first wheel had taken about 6 or 7 hrs. to feed, whilst the second had only taken about 5 hrs. Obviously, the faulty wheel had taken less metal and had a lower density, and if it had been cast hotter then the casting would have been sound. Fig. 5 illustrates the uniformity or hardness through a 3-in. thick section at ¼ in. spaces from edge to centre when cast hot and cold. The uniformity unquestionably lies with the hot-cast section.

Fig. 6 shows the above sections when fractured, and the blow-holes shown in the cold-cast section are generally, for semi-steel at any rate, a sure sign that the metal has been cast cold. The casting temperature for general cylinder and high-duty work should be between 1,350 to 1,400 deg. C.

(To be continued.)

Book Review.

Blast-furnace Practice. Vol. II. Design of Plant and Equipment. By Fred Clements. 509 pp., ill. Published by Ernest Benn, Limited. London. 1929. 63s. net.

In our issue of May 23 last we reviewed the first volume of this work. The second volume is of less direct interest to founders as such, but there are sufficient parallels between blast-furnace and cupola practice that many will like to have this new volume, particularly in connection with questions of design, refractories, the distribution of charges in the furnace, the provision and distribution of the air blast, and the instruments by which pressure and volume may be indicated and recorded. The volume is illustrated very liberally with plans, diagrams and photographs, like its predecessor, to which it appears to be in every respect a worthy successor, reflecting credit on author and publisher alike.

The work opens with choice of site and capacity, and deals with the general commercial operation of the plant. General lay-out is also considered, in relation to the by-products, which are such an important part of the output of a modern plant. These lay-outs are illustrated by photographs and diagrams of modern plants, both at home and abroad. The design of the stack, bosh and hearth is then considered, followed by refractory linings, hoppers for charge distribution, and charging and hoisting gear. The question of gas is then discussed, with the provision and distribution of air blast, hot blast stoves, and methods of dealing with indicating instruments and gear essential to the working of the furnace.

We feel sure that this volume will be welcomed quite as eagerly as its predecessor, and welcomed not merely by blast-furnace managers but by all those engaged in the purchasing o selling of pig-iron and cast iron, or in the laboratory. The final volume will deal with operation and the utilisation of subsiliary products.

The first contract for the equipment of the Buenos Aires Central Railroad and Terminal Company's new underground railway, which is being built in Buenos Aires, has been awarded to a British firm, the Metropolitan-Cammell Carriage, Wagon & Finance Company, Limited. The order is for the construction of 56 motor-coaches costing about £250,000. The electrical equipment of the coaches has been sublet by the Metropolitan-Cammell Carriage, Wagon & Finance Company, Limited, to the General Electric Company, Limited.

An Old Art Revived.

SYMBOLIC CAST DOORS AT IMPERIAL CHEMICAL HOUSE.

By H. D. Molesworth.

Symbolic is a word that has been used, or rather mis-used, so glibly of recent years that we scarcely dare to apply it to-day to any serious work of art, lest it should be thought either to be an excuse for deficient execution or a cloak to intelligibility. We can, however, safely use it in speaking of the new entrance to the Imperial Chemical House at Millbank.

The doorway itself is of immense size, 20 ft. in height and 10 ft. wide, giving the impression of a huge perpendicular window of polished silver set in a carved granite surround. Each leaf contains six cast panels, framed in a simple moulding, while the stiles are left severely plain except for rosette studs, in order to enhance the richness of the panels.

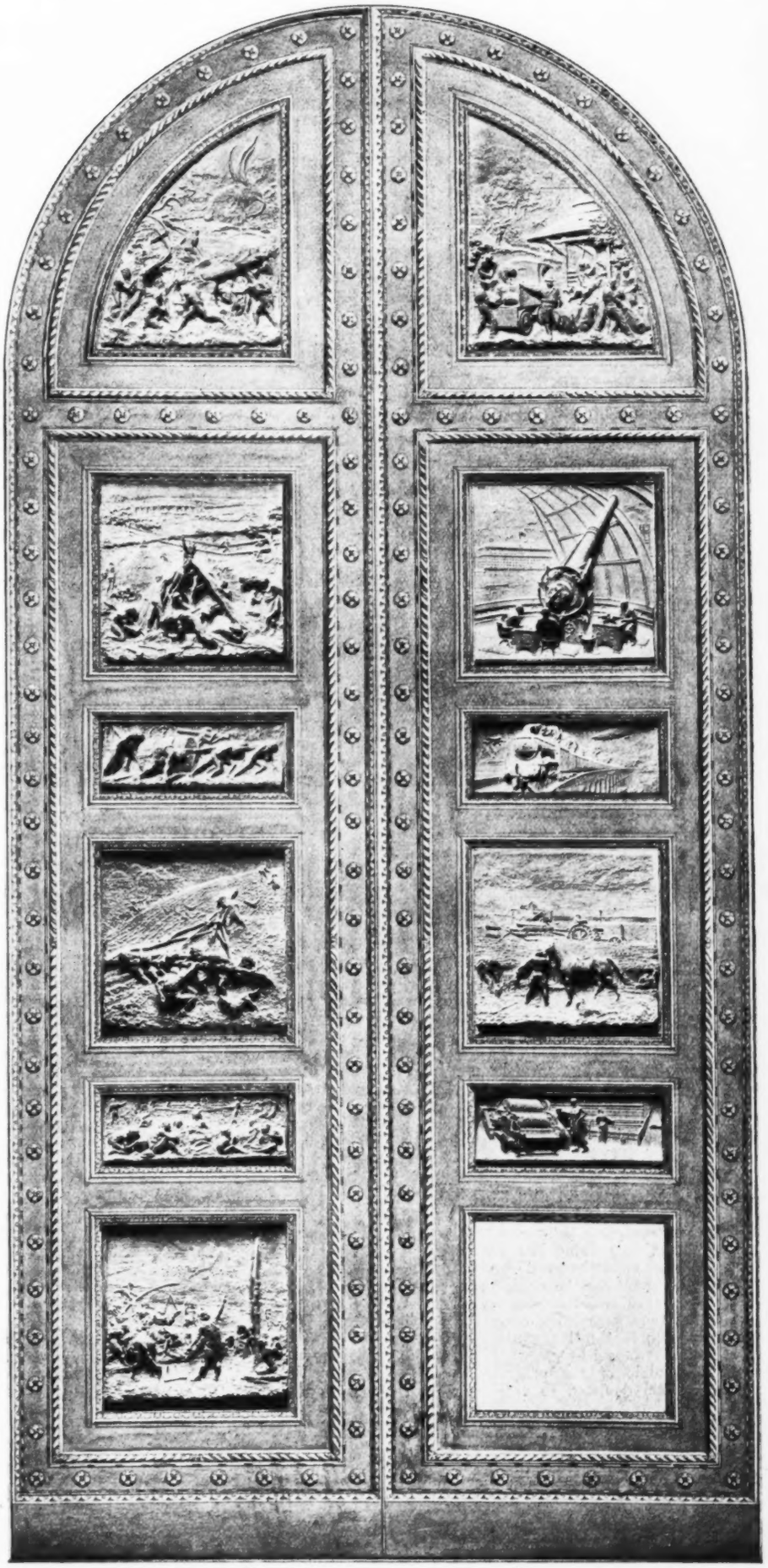
The south door illustrates the life of early man, with his primitive weapons and tools, leading a dangerous and arduous existence, while the north leaf shows us the development of modern scientific methods to which we owe not only comfort and safety, but our entire civilisation.

The panels of varying lengths are arranged in parallel, so that the scene depicted on the south door may find its modern counterpart on the north side. Thus, at the top, on the left, are shown primitive hunters in search of food, whilst on the right is seen a modern farm, with sheep and cattle; electric shearers and a motor lorry compare favourably as modern methods against the bow and arrows of the early hunters. Other panels illustrate transport, agriculture, manufacture, etc. The second pair of panels give us an excellent idea of the symbolism of the whole doorway. That which is on the south leaf depicts primitive man at work with such tools as were at his disposal. A stone adze lies in front of the hut, which is in the process of construction; on the left, a worker is using a flint scraper, and the returning harvester carries a stone sickle. In the background, a bridge of twisted-grass rope is slung between the trees, while in the distance bands of men are hauling huge blocks of stone over log rollers to build the circle. In contradistinction to this, we have the corresponding panel of the north leaf, which illustrates the modern scientist at work. The huge telescope, the spectroscope and the simple office desk convey in an immensely powerful manner the effortlessness of modern work, compared with the strained muscles and laboured efforts of the primitive tribesmen, while the huge buildings in the background and the flying boat testify to the immeasurably greater success of the effortless work with the aid of science than of the labour without it. We see this motif carried out throughout the whole of the series of panels.

The pair illustrating transport show us again on one side a fruitless application of colossal human effort to move an enormous log with grass ropes, while the corresponding panel on the north leaf shows an express train travelling at full speed over a viaduct, and an airship flying overhead.

In the panels of the south door are shown the struggles of prehistoric man. On the north leaf is depicted the age of the scientist and of power. Man still works, but his work is rewarded. We see the harvesters, the factory hands, the farmer, the scientist, at their tasks; but there are results—there are trains, machines, houses, cathedrals, aeroplanes and ships.

Before we commence any artistic criticism of these panels we must remember that they have been carried out as were Ghiberti's in his superb masterpiece, the bronze doors of the Baptistry in Florence, to convey symbolically a story to



"the man in the street," and, if they are to teach their lesson, they must be intelligible to, and appreciated by, him.

This doorway represents the revival of a neglected art, but it is a revival for a different age, an age which demands absolute realism. Extreme simplicity makes composition comparatively easy, but extreme simplicity of line and design does not appeal to "the man in the streets"; he dismisses it as dull, hideous, funny, or unintelligible, as he dismissed the work of Epstein. The storm of criticism against the proposed statue for the late Earl Haig shows that extremes of detail and realism are demanded.

We do not say that the average man does not appreciate the doors of the Florence Baptistry, or of Giotto's sculptures on the Cathedral opposite, but anyone who has spent only half an hour outside them will have heard from 90 per cent. of the foreigners, not expressions of artistic appreciation, but rather remarks in the vein of "How wonderful for all those years ago, and with only the tools they had then." It is the stupendous nature of the undertaking that impresses their minds. They feel that it is a colossal achievement "with the tools of that day," quite regardless of the fact that the tools are to all intents the same to-day as then.

It is, then, with this fact in mind that the work on the new doors for Imperial Chemical Industries has been undertaken. Decoration and effectiveness have been obtained, but not by over-emphasising obvious methods of composition. If the conception of metal doorways is a heritage from the Byzantine period, the decoration is the evolution of the late Gothic. The doors may come from mediæval Italy, but the decoration is from fifteenth-century Germany.

Fully to appreciate the work, however, it is essential that the doorway should be seen, as no photograph can give an adequate conception of the appearance either of the whole or of each panel; it does not show either the depth of the relief or the impression of the composition as seen from the ground.

The casting is of a very different nature from that of Byzantine work. It is not merely bas-reliefs, the foregrounds being in many cases in complete relief, adding a considerable "depth" to the whole. Thus the top of the wigwam and the controls of the telescope stand out, giving an illusion of complete reality.

It is in this connection that we may admire the technical ability of the artist, as we admire brushwork in a picture. Here, in six inches of metal, has been obtained as much "depth" and distance as was obtained by the best early German masters. And here it is not merely wood to be carved, but metal to be cast, thereby restricting not only the depth of relief allowed but also many of the facilities which are open to the wood carver to enhance his work.

The modernity and scientific invention are, however, not restricted to the illustrations in the panels. The electrical control of this doorway is a very practical application of modern scientific knowledge. Here are no locks, no bolts, no handles, nothing but a small electric button, worked from the inside by pressing this control. The doors can be opened and shut, or stopped half-way, should anyone try to enter or leave whilst they were being closed. Smoothly, noiselessly, effortlessly, these 2½-ton doors are closed and kept closed by electricity; a thrilling practical example of the progress of science, which has been depicted so vigorously on the front.

An order for two locomotives has been received by Messrs. Robert Stephenson & Company, Limited, Darlington, from the San Paulo (Brazilian) Railway Company. The engines are to be of the 0-4-0 type. Recently, Messrs. Stephenson received an order for 12 passenger tank locomotives for the Buenos Ayres and Pacific Railway Company.

Recent Views on the Mechanical Properties of Cast Iron.*

By Prof. Dr. Thum (Darmstadt).

[*Extract.*]

Since the fundamental experimental work of Bach at the beginning of the present century, research on the mechanical properties of cast iron has not made nearly as much progress as research work on other materials, and particularly steel. Since the successful introduction of methods of treating and improving grey cast iron, the field for cast iron has been steadily increasing, so that the time seems to have arrived when we ought to investigate the mechanical properties—which, in many respects, differ from those of steel—in accordance with modern conceptions regarding materials and their strength.

Cast iron may be regarded as steel whose structure is "perforated" or "riddled" with graphite (Goerens). This structure will readily explain the difference in the mechanical strength of cast iron and steel. Since the graphite lamellæ possess no strength they afford no supporting cross-section; and, what is, perhaps, more dangerous still, they set up increased stresses in the rest of the "steel" structure, due to notch effects. This explains the low strength of cast iron as compared with steel having the same percentage of combined carbon. On the other hand, however, the same fact explains why the elastic properties of cast iron are so different from those of steel, viz., the fact that the modulus of elasticity of cast iron is much lower than that of steel, and that the modulus of elasticity is different in different types of cast iron (between 600,000 and 1,700,000, depending on the length of the graphite lamellæ), that the elasticity modulus is different for tension and compression, that Hooke's law does not apply, and that considerable permanent strains are set up even at low stress values. It has been possible to prove experimentally that steel behaves, elastically, in a similar way to cast iron when its structure is broken by holes and slits.

In practice, the ductility in cast-iron tests is taken account of by measuring the deflection at fracture on the transverse test. The following suggestions are given for utilising the figures obtained for deflection at fracture:—

The ratio of transverse strength to deflection is approximately proportional to the modulus of elasticity, and thus enables approximate deductions to be made as to the percentage of graphite. The higher the relative figure the more finely distributed is the graphite. By simultaneously utilising the quantity and the transverse strength itself, it is possible to make deductions also as to the metallic structure of cast iron. The ascertained static work of transverse breaking can serve as a guide to the toughness of the material, provided, of course, the phosphorus content is also ascertained, as even small percentages of phosphorus appreciably diminish toughness, without affecting the static work of transverse breaking.

In addition to the continuous impact (or fatigue) test, a test of the vibrational strength is also very valuable when investigating the suitability of cast irons for the manufacture of various engineering components. Experiments have shown that the vibrational strength, as determined on the Schenck continuous bending test machine, amounts to about 35 to 45 per cent. of the tensile strength, so that high-quality pearlitic irons exhibit a vibrational strength of approximately plus or minus 12 kg./mm.^{2} (7.6 tons/sq. in.), medium-quality cast irons about plus or minus 9 kg. (5.71 tons/sq. in.), and ordinary machine cast iron about plus or minus 6 kg. (3.80 tons/sq. in.). Where the surface is injured artificially, the higher-graphite cast irons are, relatively speaking, less sensitive to notch effects than the high-quality cast irons, since the vibrational strength of a high-graphite cast iron, even where measured on the polished bar, is considerably reduced, due to the high notch-effect of the coarse graphite veins.

* A Paper read before the 59th Annual General Meeting of the German Foundry Employers' Federation held at Düsseldorf last month.

I.B.F. Elects New Members.

At the General Council meeting of the Institute of British Foundrymen, held at the Central Station Hotel, Newcastle-upon-Tyne, on October 12, the following gentlemen were elected to its various grades of membership.

As Subscribing Firm.

Taylor Bros. (Sandiacre), Limited, General Engineers and Ironfounders.

As Members.

W. Aske, Foundry Supplier, W. Aske & Company, West Parade, Halifax; A. E. Cadman, Joint Managing Director, G. Garner & Sons, Openshaw; G. N. Cook, Foundry Engineer, English Steel Corporation, Limited; H. Crawshaw, Engineer and Metallurgical Agent, 275, Rue Victor Ranter, Anderlicht, Brussels; L. Dykmans, Commercial Manager, Negler & Company, 82-6, Rue Everaerts, Antwerp; C. Gutteridge, Traveller, Effingham Mills, Rotherham; R. P. Hall, Engineer, Qualter Hall & Company, Railway Foundry, Barnsley; H. Harrod, Foundry Foreman, Vulcan Ironfoundry, Thornaby-on-Tees; D. H. Ingall, D.Sc., Principal, Constantine Technical College, Middlesbrough; W. J. Kitching, Manager, Leigh & Sillavan, Limited, London, W.C.2; F. P. McManus, Director, Major, Robinson & Company, Manchester; A. Negler, Foundry Proprietor, Negler & Company, 82-6, Rue Everaerts, Antwerp; H. J. Ross, Foreman Moulder, Harland & Wolff, Limited, N. Woolwich; T. Shanks, Foundry Manager, Denny Iron Works, Denny; H. Taylor, Manager, Excelsior Foundry, Sandiacre, and F. Andrew, Foundry Manager, Ferranti, Limited, Hollinwood.

As Associate Members.

B. Brodie, Foreman Iron Moulder, R. W. Crosthwaite, Limited, Thornaby-on-Tees; W. Brunt, Moulder, Central Marine Engine Works; F. P. Coleman, Charge-hand, English Electric Company, Rugby; A. Cooper, Moulding Machine Fitter, E. Stevenson, Limited, Nottingham; G. H. Hill, Moulder, Rice & Company, Eagle Foundry, Northampton; E. A. Holman, Moulder, English Electric Company, Rugby; C. J. Lake, Foundry Assistant, Lake & Elliott, Braintree; J. T. Leah, Foreman Brass Moulder, J. Hetherington & Sons, Manchester; R. B. Mansell, Blast-Furnace Manager, Cochrane & Company, Middlesbrough; E. Mee, Foundry Foreman, Midco Steam Specialities, Nottingham; W. G. Pemberton, Foundry Foreman, English Electric Company, Rugby; E. H. Slater, Sales Manager, Dunford & Elliott, Limited, Sheffield; S. White, Foundry Proprietor, Mill Foundry, Sandiacre, and F. Whitehouse, Assistant Foundry Foreman, Hargreaves & Jennings, Limited, Tottington.

As Associate.

Frank Acton, Coremaker, Midland Motor Cylinder Company, Limited, Smethwick.

The English Steel Corporation, Limited, and Messrs. John Brown & Company, Limited, are to share an order for sixteen steel reaction chambers required in connection with oil-distillation plant which the M. W. Kellog Company, of Jersey City, U.S.A., are to supply to the Anglo-Persian Oil Company. Messrs. John Brown & Company, Limited, have also booked an order from Messrs. Babcock & Wilcox, Limited, for high-pressure boiler drums required for the new Ford motor works at Dagenham.

Creating an Engineering Foundry.*

By W. G. Thornton.

Founding must be admitted to be the foundation of the engineering industry; in fact, castings of one kind or another are the foundation of all mechanical devices and contrivances, which is tantamount to saying that they are of vital importance to everything we use, wear, eat and travel on. In this mechanical age everything is done more or less with machinery, and the foundries' work is the foundation of these machines. The foundry generally is given very scant consideration, both as regards its site, design, equipment and management.

Foundry as a Department.

As a rule a foundry is the part of an engineer's business about which he knows least, and it is the part in which the personal qualification counts for more than in almost any other department. It has been the practice in engineering from its commencement for foundries to be run as independent businesses, and one would therefore naturally conclude that there must have been some important consideration that led to this development. It might well be argued that the founder's art is one requiring so much personal attention that success could only be obtained by devoting to it the entire attention of the heads of the firm, who themselves would need to be practical foundrymen.

Undoubtedly there is a good deal of risk in the foundry business, and skilled management is certainly required. It might, therefore, be considered that an engineer tendering for contracts and basing his price for the work on the assumption that he would obtain good materials, would, by buying his castings, lessen his risk. It could be argued that castings were, after all, raw materials like forgings, bar iron and steel, and that the production of them was outside the province of an engineering works.

If, however, in spite of these statements, it be admitted that there are no positive reasons why a foundry should not form a beneficial part of an engineering business, and that, even as a man does not need to be a first-rate turner in order to manage a machine shop, so it may be argued that it is not necessary for him to be an expert moulder to run a foundry.

Determinative Factors.

An important consideration is the control of the foundry facilities obtaining a supply of good castings, because it often enables the output of the whole factory to be better regulated and in many cases increased. Everyone who has had anything to do with the management of an engineering factory knows the importance of getting the materials ready well ahead of the machine shop, and how provoking and wasteful it is when certain parts are lagging behind the rest. Very often some of the castings are missing, and it requires much care and watchfulness to prevent this. It may generally be noticed that the castings which make weight are delivered quickly and regularly, but the difficult and light parts are invariably behindhand. The peace of mind of the management is not increased by finding a large piece of work, worth, say, hundreds of pounds, waiting the arrival of a casting worth a few shillings. It does not necessarily follow that such omissions will not occur in the works foundry, but there is certainly very much less likelihood of it happening, and if it should happen the omission is more rapidly made good. Again, the stock of castings in the foundry stores can be more closely regulated, and the system of maximum and minimum stocks introduced, which would often be impracticable without a works foundry.

Then there is the cost of the castings to be considered. This is a very important item. It might be enumerated as a fairly safe rule that where large quantities of general engineers' castings are required, and where there is a good deal of repetition work, and sufficient in quantity to keep a moderately sized foundry employed, then the foundry attached to the factory and specially designed for such work should produce the castings more economically.

Presuming the castings required are not of the repetition order, and that they alter fairly considerably in size and design from day to day, then the problem of reducing costs becomes more difficult, and a very important consideration is whether the quantity is such as will permit of production at a low price. There are also several other matters which need careful consideration, such as the comparison of the weight of individual castings made or purchased; also the purchase of raw materials in sufficient quantities so as to obtain the best market value, and last, but not least, whether the turnover will be sufficient to warrant the outlay and the establishment charges that will be involved.

Improving the Castings.

It may happen that whilst sufficient castings can be purchased at a reasonable price, the quality is unsatisfactory. Outside foundries may not consider it worth while to make the necessary tackle to turn out the best work, especially if they are not sure that the job will be repeated. Generally speaking, a works foundry should have a better chance of turning out these special castings.

There should be better co-operation between the designer, the patternmaker, the foundry foreman and the works manager. Further, the supervision of the purchase of raw materials being in the hands of the management, a better selection can be made to suit any special requirements.

This question of quality is a most important one, bearing on the cost of machining the casting and the general appearance of the finished articles when completed. The engineering manufacturer is well aware of the necessary dressing, filling in, rubbing down, painting and varnishing which are necessary to give a satisfactory appearance to his goods, and the slow and costly process it becomes. However well it may be done, no painter can fill in and finish off badly moulded castings and give the nice clean lines of design which give pleasure to the designer and to the commercial side.

Convenience of Foundry Departments.

Quite apart from the regulation of the supply of castings there are some other important advantages in being in close touch with the foundry. The patterns can be watched more closely, repairs can be more promptly made and the patterns kept in better condition. Outside foundries are often hard on patterns, this being due to the lack of a little mending in time. Designs can in many cases be simplified and improved by noting the progress of the work in the foundry.

It is also a great advantage to have the head patternmaker in conference with the foreman moulder when new patterns are being made. Such conferences often enable small unimportant changes in design to be made, which simplify the moulding and thus lower the cost of production. The drawing office also has the advantage of seeing the work more in progress, and can correct and improve its work with less delay and cost.

Choice of Site.

The nature of the ground upon which it is proposed to build must be considered. The land must be as free as possible from water, otherwise there will be trouble in keeping it out of the floor. If there should be any danger of water coming in from the surrounding land it will be best to enclose the whole foundry by a large drain.

The foundry should be placed with spacious open yards at both ends and one side if possible, and the general plan would be for all the raw material to be delivered in the yard at one end, either by road or rail, and all finished castings be dispatched from the other. The point of delivery should be convenient and handy for the casting store and machine shops.

It is desirable to place the foundry so that its least objectionable side abuts any neighbouring property, and for this reason the cupolas, charging stage, blower room and power house should be placed on the side farthest from the adjoining property, as there is a danger of receiving complaints of dirt and smoke from the cupolas and noise from the blower room and power house.

Design of the Building.

Judging by a large number of foundries this question does not appear to have received due consideration. At best the foundry is a dirty place, and therefore the building should have greater consideration rather than less. For general engineering work a portion of the foundry is required for heavy work and the remainder for light castings. To be able to deal conveniently with the heavy work the building should have ample head room, and be constructed with due regard to the strains arising from lifting heavy weights.

Possibly the best design for most foundries producing heavy and light castings is to have one or more middle bays, the roofs of which are supported on built-up steel stanchions, which also support the crane rails. Further bays of a lighter design can be arranged at each side for the small castings, bench moulding, core making, etc.

Whether the whole building should be constructed as a skeleton in steel work, having the sides and ends filled in with light brickwork or other material, or whether the outer walls should be of substantial brickwork with only steel stanchions in the middle bay or bays, is a matter of opinion.

It would depend on the class of work to be produced whether pits should be provided in the moulding floor or not. The same remarks would apply as to whether anchor bolts should be fixed in the floor for bolting down large top boxes, thus avoiding the use of heavy weights, etc.

The charging platform should be completely enclosed and roofed in like an upper room and amply ventilated. It is then entirely protected from the weather. The charging floor should be formed of steel plates resting on substantial steel girders and joists, and should have adequate storing capacity.

The walls of the foundry should be pierced with a large number of windows, and there should be a good deal of glass in the roof, the result being that under ordinary conditions the foundry should be well lighted.

Foundries have a tendency to be dark, the floor being chiefly black reflects little light, and although many windows may require much cleaning the advantage of light is well worth the expense.

Management and Division of Labour.

This is a debatable question. It is possibly the best plan to have a head foreman who has complete charge of the foundry under the supervision of the works manager. The appointment of the under-foreman should be left largely to the discretion of the head foreman, and he should be consulted upon all materials required for the foundry, such as the best brands of iron to be used, quality of coke, etc., it being understood that he is held responsible for the quality of the metal in the finish castings. Whether this arrangement can be improved upon by the intro-

* A Paper presented in lieu of a Presidential Address to the West Yorkshire Section of the Institute of British Foundrymen. Mr. H. Sayers in the chair.

duction of a metallurgical chemist is a matter for consideration which largely depends on the class of castings being produced.

In some foundries a chemist has been appointed, whose duty it has been to take charge of the cupolas, the mixing of the irons, and to deliver to the foundry foreman the quantity of metal he requires in the molten state at the hour decided upon.

The chemist should have a laboratory placed in a position near the charging platform for the purpose of analysing all the materials used in the cupolas. With this knowledge he is able to make his mixtures to suit any quality of metal required, and to do this by using cheaper grades of irons, mixing one brand with another to correct and improve the quality as required. The system has much to recommend it, and the extra expense is many times recouped in the saving of cost in the purchase of raw materials.

So long as everything is proceeding satisfactorily, the works manager has no difficulty, but when the "wasters" appear then the trouble commences. Who is responsible for the bad work? However much care is taken to investigate the occurrence by a rational and practical inquiry, it will be found most difficult to avoid "friction" developing between the foreman and the chemist.

It is often asserted by the foundry foreman that when trouble comes the chemist rarely, if ever, places any information before him that helps to remove the difficulty, and the chemist may say that the true facts have not been placed before him. It is reasonable to presume that the work done by the chemist must be valuable, and that it is in the application of this work the system is imperfect.

Possibly the best method to obtain the best advantage of this system of working the foundry would be to have a foundry manager who would take complete control, and he would appoint and direct the chemist and the foundry foreman. When any wasters appeared he would decide the cause and deal with it accordingly.

Of course, it would be necessary for the foundry manager to have the theoretical knowledge of the chemist and also the practical experience of the foundryman. Unless such a manager is in charge it would appear that the advantage of having a chemist is very doubtful, although one is reluctant to forgo his services, if by his assistance cheaper brands of pig-iron, etc., can be used and the quality of the molten metal can be relied upon to suit all purposes.

Power and Light.

If it can be arranged for the foundry to have a supply of power from the works, and to be relieved from the trouble of its own motive power, that will probably be found the most convenient arrangement. The amount of power required in a foundry varies very much at different periods of the day. In the afternoon, when the blower or fan is at work, and the cranes busy, the load is heavy, the foundry requires energy in many forms. It would be difficult and very inconvenient to arrange to drive everything in the foundry direct from shafting. Electric power will be found very serviceable and handy.

Direct electric energy will not, however, be the best for every purpose. If moulding machines are used, compressed air or hydraulic power will be necessary. Hydraulic power can be usefully applied to many purposes, and therefore it may be desirable to have electric energy, compressed air, and hydraulic power installed. Possibly it will be found that by using electric and compressed air all the various appliances in the foundry can be simply, economically and effectively operated. As most engineering works have now both electric current and compressed air installations it can often be arranged for the foundry to be supplied from the works power station, charging the foundry for such power on a fair basis.

Compressed air will be found very serviceable for blowing out moulds and for blowing dust and dirt from cranes and other appliances. It may be argued that hydraulic power is best for some purposes, such as moulding machines, jib cranes, and the cupola hoist, by reason of its steadier motion, but the question is whether the advantages to be gained by hydraulic power are worth the expense of the installation.

A foundry is a very difficult place to light effectively, and all forms of artificial light have their disadvantages. Gas lighting is out of question; the arc lamp does not show to advantage in the atmosphere of the foundry at the time of casting. Incandescent lamps burning oil under pressure have been used, but possibly, all things considered, the ordinary electric lamps of, say, 200 to 500 watts, prove to be the best. The lamps should be placed in the centre of the bays and fairly high up.

Equipment.

Of course, it will be understood that the necessary equipment for any foundry will depend largely on the nature and size of the castings to be produced, but the following will serve as a guide and show that the requirements of a foundry are fairly considerable.

Cupolas; electric cranes; jib cranes; cupola hoist; electric or loco. jib crane in the yard which can be used for hauling trucks of raw materials, unloading, and supplying the foundry with moulding boxes and tackle which are usually stored in the yard; blowers or fans for cupolas; sand mill, moulding and core sand mixing machine, sand sifter, mechanically-operated riddles; weighing machines of various sizes (one suitable for the weighing of cupola charges placed on cupola platform).

For inside the foundry itself provision will have to be made for the drying of moulds and cores. The capacity of ovens and drying appliances will depend to a large extent on the class and the size of castings being produced, therefore under this heading we will just say core ovens and portable drying appliances complete with carriages, etc.; moulding machines, with the necessary tackle, etc., for the manufacture of pattern plates; moulding boxes; bottom plates; weights; clamps; bars; gaggers, etc.; additionally there are the tools and tackle required by the moulders themselves. Then there is all the lifting tackle, including chains, beams, hooks, slings, etc.; ladles of various capacities, hand ladles and shanks. It may also be advisable to consider the question of runways for the transportation of metal to the side bays and of the sand to and from the sand-mixing department to the moulding floors.

The fettling department will also require its share of machinery, the most important of these being the following:—Rattlers or tumbling barrels, possibly a sand-blast plant, emery wheel grinders (both fixed and portable), dust-removing plant, pneumatic hammers, and maybe a pickling tank.

The foreman should be provided with an office in a position if possible where he can view the whole foundry. This should be fitted with the necessary files and lockers for the filing of his cost records, drawings and instructions. Time and cost clerks should be housed in an office adjoining the foreman's, and the time and job card pegging clocks should be attached to the walls of this office.

The chemist should have his laboratory as near to the cupolas as possible, and all measuring instruments, such as blast and volume meters, gauges, etc., have their recording mechanism in here.

It is advisable for a foundry of any size to be provided with a stores where all small tackle could be kept; also to be provided with bins for holding studs, chaplets, nails, sprigs, pipe nails, etc.; shovels, hammers, brushes, mallets, chisels, bolts and nuts, clamps, wedges, etc.

(To be continued.)

Detecting Copper in Steel.

QUALITATIVE TEST.

The increasing vogue of making small additions of copper to steel for all purposes where iron parts, either galvanised or ungalvanised, painted or unpainted, are exposed to atmospheric conditions, has focussed attention on difficulties which may be encountered by assembling copper with copper-free steel. Some manufacturers are using coppered steel exclusively.

Since, however, small additions of copper have practically no influence on the strength and machining properties of steel, no difficulty is likely to arise in this connection where isolated components of copper-free steel are assembled with components containing copper. It is unlikely that the minute potentials set up will aid corrosion so long as the structure is not immersed. Corrosion never occurs so uniformly that the entire structure need be repainted where isolated portions of the paint are destroyed, so that if only a few portions of the structure are free from copper this will not detract from the service life of the structure in which copper steel is used.

Notwithstanding these facts, it may be desirable in some instances to prevent confusion arising by the use of copper and copper-free steels, or the purchaser may wish to confirm that the steel supplied actually contains copper. The methods usually employed in the determination of copper requires a well-equipped laboratory, which is not always available. The following simple method, outlined in "Stahl und Eisen", affords a ready means of determining the presence of copper.

In the process of pickling, copper steel soon becomes covered with a very weak but quite perceptible reddish film, whereas steel that contains practically no copper exhibits the conventional silver-grey colour after pickling. Closer investigation showed this deposit to consist of copper in a fine state of division. This deposit is obtained most easily when the material tested is heated in an oxidising atmosphere to 800 to 885 deg. C. before pickling. The method consists in pickling the annealed material in dilute hydrochloric acid (33 per cent.). If the copper content is less than 0.12 per cent. the surface, after the annealing scale is stripped off, is silvery to dull grey. Steel containing over 0.20 per cent. copper assumes, after about 20 min., a spotted or uniformly copper-red colour, which increases in intensity with increase in the percentage of copper.

Iron and Steel Output in September.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of September was 168, a net decrease of two since the beginning of the month, one furnace having been blown in and three having ceased operations. The production of pig-iron in September amounted to 664,600 tons, compared with 682,000 last August and 503,900 tons in September, 1928. The September production included 208,500 tons of hematite, 284,700 tons of basic, 121,200 tons of foundry, and 23,200 tons of forge iron. The September output of steel ingots and castings amounted to 847,900 tons, compared with 753,300 last August and 718,600 tons in September, 1928.

Norwegian whaling companies have placed contracts for two Diesel-engined vessels of 11,300 tons and 9,400 tons deadweight respectively. One vessel is to be built by Messrs. Swan, Hunter & Wigham Richardson, Limited, of Wallsend, and the other by Messrs. Barclay, Curle & Company, Limited, Glasgow.

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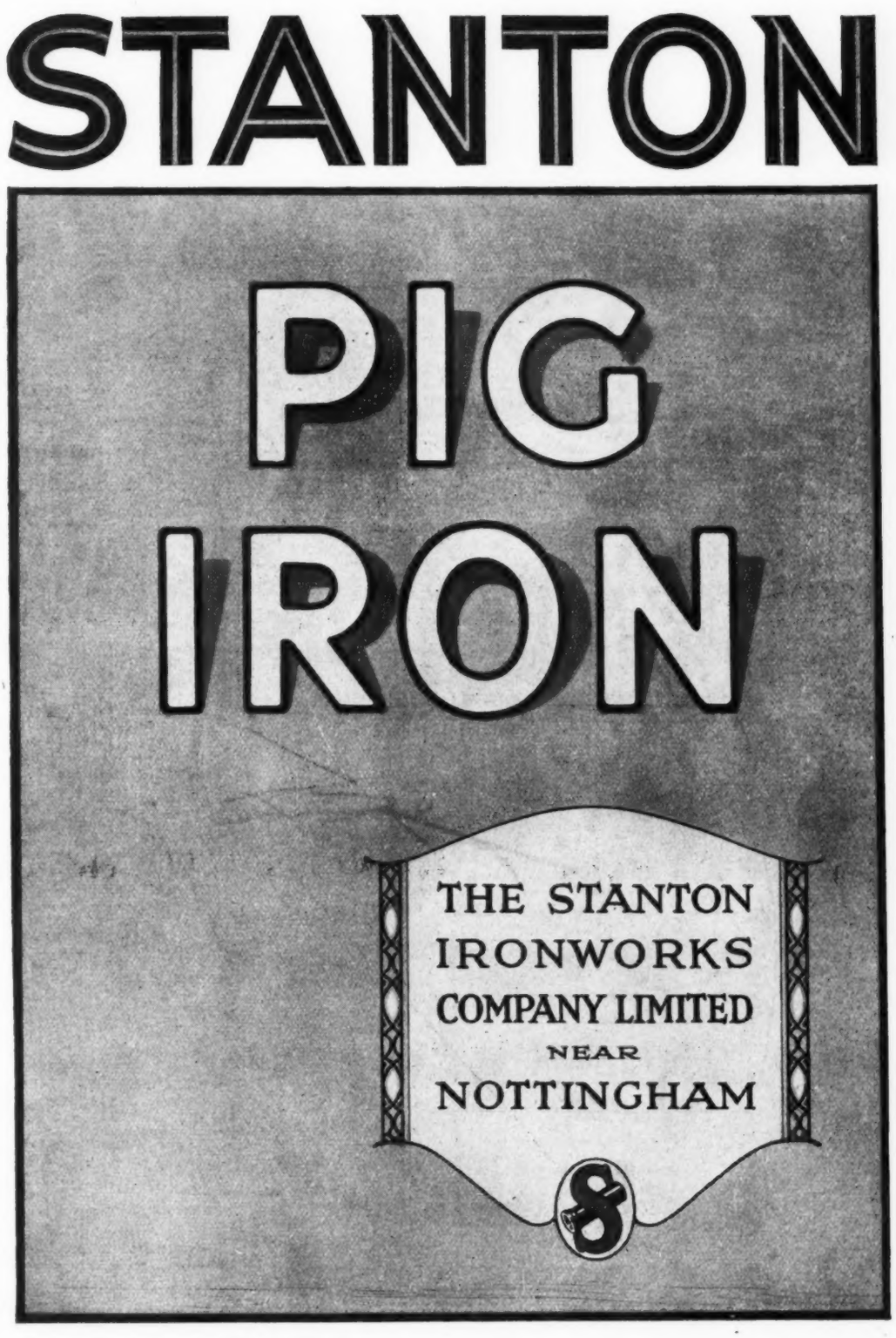
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Trade Talk.

Messrs. R. Y. Pickering & Company, Limited, Wishaw, Lanarkshire, have received an order from the South African Railways for 500 pairs of wheels and axles.

The employees of Messrs. William Beardmore & Company, Limited, Naval Construction Works, Dalmuir, have contributed £1,525 to various charitable institutions.

Messrs. Alexander, Stephen & Sons, Limited, Linthouse, Glasgow, have received from the British India Steam Navigation Company an order for two twin-screw geared turbine passenger liners, each 470 ft. in length.

A railway electrification scheme which will cost £2,000,000 is announced by the Southern Railway. A total railroad linage of about 70 miles is to be electrified, and work on the scheme is to be begun within the next two months.

The Government has promised to hold an inquiry into the position of the Tyneside shipbuilding industry, which, it is declared, has been heavily hit by the policy of disarmament. This step, it is reported, has been taken following representations made by a deputation from Tyneside trade unions.

Twin trawlers of 122 ft. in length, built to the order of Messrs. Richard Irvin & Sons, Limited, were recently launched from the shipyard of Messrs. Hall, Russell & Company, Limited, Aberdeen. The vessels are the sixtieth and sixty-first built since 1899 by Messrs. Hall, Russell for the same owners.

Much alarm was created last week in Dalmuir and Clydebank by an explosion which occurred in the naval construction works of Messrs. William Beardmore & Company, Limited. The noise of the explosion was heard at a considerable distance from the works, and it appears that a compressor in the gas plant blew out, but no one was injured.

The inaugural meeting of the tenth session of the Carron Company's Works Recreation Club took place on October 16. The president of the club, Mr. M. H. Medcalfe, occupied the chair, and was supported by Mr. George Pate, O.B.E., general manager of the Carron Company; Mr. Collings, the company's London representative; and the departmental heads.

The Ardrossan Dockyard, Limited, have launched the single-deck cargo steamer "Baron Dechmont," 350 ft. in length between perpendiculars, 50 ft. moulded breadth, 25 ft. 9 in. moulded depth, and of 3,650 tons gross. The vessel, which has been built to the order of Messrs. H. Hogarth & Sons, Glasgow, will have machinery supplied by Messrs. John G. Kincaid, Limited, Greenock.

The National Union of Foundry Workers has applied to the Scottish founding section of the North-West Engineering Trades Employers' Association for the restoration of the penny per hour on time rates which was deducted from the wages in 1922. A conference has been arranged to discuss the claim. About 7,000 foundry workers, mainly employed in Glasgow and the West of Scotland heavy industries, are affected by the application.

The employees of Messrs. William Beardmore & Company, Limited, at Mossend were informed on October 12 that the works welfare scheme, including the recreation grounds of 18¼ acres were being closed down indefinitely. The works have been idle for about a year and a-half, and it was impossible for the workers to contribute a levy. Such funds as yet remain at the credit of the scheme are required to meet local taxation. The scheme was one of the largest in the country.

Important new developments in the light castings industry in Falkirk are reflected in a lining which was granted at Falkirk Dean of Guild Court on October 17. The Grangemouth Iron Company, Limited, Grange Iron Works, Falkirk, were granted permission to extend their moulding shop at the works by adding a new bay to the south side, the building to be of steel on a concrete foundation, filled in partly with brick and partly with asbestos sheeting, and the roof to be covered with glass in steel astragals. The estimated cost is £3,000.

A distressing accident at the Glasgow Iron & Steel Company's works, Wishaw, early in September resulted in the death of a blastfurnaceman, William Jackson. At an inquiry last week it was stated that the man was engaged in removing protecting plates from a slag truck. His foot slipped, and he fell beneath the truck into a pool of boiling water which had drained from the truck after it had been poured over the slag at the furnace. The foreman stated that whilst being attended to in the ambulance room, Jackson said that he had slipped off the wagon because he was wearing new hobnailed boots; he clutched the side of the truck, but the heat caused him to release his hold, and he fell into the boiling water. A formal verdict was returned.

Workers engaged in the shipbuilding and allied trades in Aberdeen will regard as good news the announcement that two more orders have been added to those in hand. The orders which have been received by Messrs. John Lewis & Sons are from Australian firms, for vessels which are to trade between Newcastle, New South Wales and Australian ports, and Australia and New Zealand. One of the orders is for a 500-ton collier of a special type, placed by Messrs. R. W. Miller & Company, Sydney. This vessel will be equipped with special coal-handling gear. The other order has been placed by Messrs. R. W. Lamb & Company, Sydney, and is for a vessel of 1,600 tons deadweight for the New Zealand trade. It is understood that, with these and the orders already in hand, Messrs. Lewis's shipyard will be kept fully employed for more than a year.

Mr. Frank Hodges has been appointed to the new board of directors of Messrs. William Beardmore & Company, Limited, of Glasgow. His appointment was made by the Bank of England. Mr. Frater Taylor and Mr. B. H. Binder have been added to the directorate in similar circumstances. The board now consists of Mr. Lewis C. Ord, as managing director, Mr. John Black, Colonel T. W. Bonner, Mr. A. G. Macfarlane, Mr. Hodges and Mr. Binder, and Mr. Frater Taylor as chairman. The board will not have exclusive control of the concern, as a small control committee representing the Bank of England, the joint stock banks, and the Government has been appointed to be associated in the handling of the future affairs of the company. The members of the committee are Sir James Cooper, Mr. Frater Taylor and Mr. W. Payne.

Mr. A. K. Wilson, of Messrs. Joseph Rodgers & Sons, Limited, Sheffield, was recently installed as Master of the Company of Cutlers in Hallamshire, and in his subsequent address he spoke of the succession of years of depression in the trade and commerce of Sheffield, and appealed to the Government to assist the cutlery industry by continuing the Safeguarding duties. He also urged that the question of the rationalisation of the lighter steel trades should be fully investigated. Formerly, he said, when output in any trade exceeded demand, the only thing that could happen was a suicidal struggle for the survival of the fittest. Latterly a new and better alternative had been found, rationalisation, or amalgamation and the rationing of decreased demand among the most efficient units, the remainder being closed down. Under this scheme not only should all shareholders receive something equivalent to the real value of their investment and creditors incur no loss, but, what was even more important, the industry itself should emerge in a far stronger position than it ever was before to meet outside competition.

The board of Allied Ironfounders, Limited, announce that immediately the recent events in connection with the affairs of the Austin Friars Trust, Limited (who were concerned in the formation of the company), came to their knowledge, instructions were given to the company's auditors to investigate fully the affairs of the company, in relation to its formation and the issue of its share capital and debenture stock. The board has now received a report from the auditors, which states that, as far as can be ascertained, the position of Allied Ironfounders, Limited, and its issues of share capital and debenture stock is unaffected by recent events, except that in the account between the company and the Austin Friars Trust, Limited, dealing with the formation of the company, the payment of preliminary expenses and of the debenture stock issue, there is a balance due to the company by the Austin Friars Trust, Limited, of £56,950 before charging interest. The extent by which this figure may be reduced is now under investigation, but the amount of loss when ascertained is amply covered by the reserves of the subsidiary companies. The directors are satisfied that the events referred to above will cause no interference with the normal conduct of the company's business, and that none of the subsidiary companies in which this company has a controlling interest is affected in any way. The subsidiaries of the company continue to be well supplied with orders.

Personal.

Mr. W. D. Woolley, general manager of the Tredegar Iron & Coal Company, Limited, has been elected a patron member of the South Wales Branch of the Association of Mining Electrical Engineers.

Mr. H. Winterton, of Moorlands, Milngavie, Dumbartonshire, president of the Scottish Branch of the Institute of British Foundrymen, is a candidate for election to the Town Council of Milngavie.

Mr. Albert Edward Poole, who for 12 years has been blast-furnace manager at the Thorncliffe Ironworks of Messrs. Newton, Chambers & Company, Limited, has resigned in order to take up an appointment with Messrs. Walter Scott, Limited, Leeds Steel Works.

Mr. J. W. Frier, who was for many years foundry manager at the North-Eastern Marine Works, Wallsend, and later at Messrs. Crosthwaite, Thornaby-on-Tees, is taking up a similar position with the Caledon Shipbuilding & Engineering Company, Limited, Dundee.

Mr. H. Spence Thomas, managing director of the Melingriffith Company, Limited, and a director of the Blaenavon Company, Limited, and other iron and steel companies, was a passenger in the Canadian Pacific liner, "Empress of Canada," which went ashore on Vancouver Island on October 13.

Sir Reginald S. Holland, Bt., and Sir Charles W. Fielding have resigned their seats on the board of the British Metal Corporation, Limited. Sir Evelyn A. Wallers and Lieut.-Col. the Hon. R. M. Preston, who have acted as alternative directors for them respectively, have been appointed in their places.

Wills.

Kidston, W. H., chairman of Messrs. A. G. Kidston & Company, Limited, iron and steel merchants, Glasgow...	£112,525
Sartoris, Leonard, Cardington, late chairman of the Kettering Iron & Coal Company, Limited	£19,686
Muxlow, T. H., Sheffield, a director of Messrs. R. & J. Smith Bros., Limited, iron, steel and metal merchants, of Sheffield	£3,096

Obituary.

Mr. Edward S. Barnett, chairman of the Cannon Iron Foundries, Limited, Deepfields, Staffs, died on Friday, October 11, in his 80th year.

Mr. Sam Whitmore, who had been for many years chief engineer for Messrs. John Lysaght, Limited, at their Newport works, died on Sunday, October 13, aged 70.

Mr. William Somers, third son of the late Mr. Walter Somers, founder of Messrs. Walter Somers, Limited, Haywood Forge, Halesowen, died recently, aged 51. He was a director of the company for a long period.

Reports and Dividends.

Steel Ceilings, Limited.—Net profit, £10,269; final dividend of 5 per cent., making 10 per cent.; to income-tax reserve, £1,150; carried forward, £1,019.

Denaby & Cadeby Main Collieries, Limited.—Profit, £10,546 (after appropriating £10,000 from reserve for taxation); brought in, £15,712; carried forward, £14,258.

British Metallising Company, Limited.—The first report, for the period to June 30 last, shows a loss of £10,582. The sum of £3,361 has been expended on development work, etc., directors' fees absorbed £2,393, and depreciation £410. Preliminary expenses were £2,659.

New Companies.

Manganese Corporation, 1929 (British Sales), Limited, 22, Queen Anne's Gate, London, S.W.—Capital £5,000. Directors: D. C. Holmes and L. W. Cross.

M. C. Irwin & Jones (Cardiff), Limited, Canton Sidings, Grangetown, Cardiff.—Capital £1,000. Metal refiners and merchants, etc. Directors: T. Jones (chairman) and M. C. Irwin.

Grange Coal Company, Limited, Milburn House, Dean Street, Newcastle-upon-Tyne.—Capital £4,000 in £1 shares, to take over the business carried on at Grange Colliery, Belmont, by the Grange Coal Company. Directors: C. Wilkinson, F. C. Wilkinson, J. Wilkinson and G. E. Taylor.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The absence of any marked activity in the Cleveland iron market of late may reasonably be accepted as an indication that autumn purchases have not yet been fully met by deliveries, which, in many instances, cover the remainder of the year; thus ironmasters are in no immediate anxiety as regards the disposal of outputs of ordinary foundry iron. An important fusion of two of the principal furnace interests in the Tees-side area, recently announced, has so far had but little effect upon the position of the North-East Coast industry, and, as competition among local pig-iron producers has practically ceased for a long time, the amalgamation in question is unlikely to have an effect on the present system of fixed prices. Nevertheless, the outlook is not wholly reassuring. Some of the local steelmakers are using cheap foreign iron, and very little Cleveland iron is being exported, while steelworks consumption is falling off. Pig-iron shipments from the Tees have not been so heavy during the past week, but over the first 14 days of the month they total 14,904 tons, compared with 12,736 tons to September 14. Minimum fixed prices still remain:—No. 1 Cleveland foundry iron, 75s. per ton; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; No. 4 forge, 71s. per ton.

The market for East Coast hematite still maintains its recent activity, both as regards home and export trade, with prices on a slightly firmer basis. Unfortunately, however, costs of production are still rising, and some of the makers are refusing to sell mixed numbers at below 77s. per ton, though there are holders who would not refuse business at 76s., and the middle figure may be accepted as an average market quotation, with No. 1 quality at 77s. per ton. On the North-West Coast, Bessemer mixed numbers are quoted at 77s. per ton at works.

LANCASHIRE.—Quiet conditions continue to rule in markets for foundry pig in this area, though deliveries on forward commitments are being made with consistent regularity. Inquiry so far as new business is concerned has been of limited extent, and the orders actually placed have not been heavy in the aggregate. Current quotations for delivery to local consumers are at 77s. per ton for both Staffordshire and Derbyshire No. 3 brands. In the case of Scottish makes, prices remain very firm at about 92s. 6d. to 93s. 6d. per ton, delivered equal to Manchester.

THE MIDLANDS.—Demand for foundry iron in the Black Country area continues fairly active, and is expected to remain so over the remainder of the year. Quotations based on the zone system are firm at the minimum prices of 75s. for Northants No. 3, 78s. 6d. for Derbyshire No. 3, and 79s. 6d. for North Staffordshire No. 3, delivered local stations.

SCOTLAND.—The condition of the Scotch pig-iron market continues very sluggish, and consumers generally are buying sparingly, with a few exceptions. In some cases, where buyers have iron bought ahead, they are in arrears in taking it out. Notwithstanding the limited business being put through, prices are very firm at the official minimum of 76s. per ton f.o.t. furnaces for No. 3 Scotch foundry pig-iron.

Finished Iron.

In the manufactured iron department, demand for Staffordshire marked bars continues fairly active at the advanced quotation of £12 10s. It does not, therefore, appear that the increased figure has caused any diminution in the demand, and works making this quality iron are fairly well situated. There is, however, no improvement in the call for crown bars, and specifications now coming through from stock warehouses and consumers are of a very miscellaneous character. Staffordshire crown iron is at about £10 per ton, but outside this area supplies are obtainable at 5s. per ton less. Nut and bolt iron is quoted at between £9 and £9 5s., but little business is possible at this level in view of the Continental competition.

Steel.

The outlook in the steel markets for both finished and semi-finished material is uncertain. There has, however, been some inquiry for finished steel, and buying is reported by structural engineers, although the demand from stockholders is said to be unusually quiet for the time of year. Overseas inquiry has increased somewhat, and this has encouraged the market to hope that the lethargy in the export markets is passing. In the tinplate market the tone is firm, with quotations ruling at 19s. basis for coke qualities, net cash, f.o.b. Welsh ports.

Scrap.

Business in the various markets for foundry scrap metals is now only on a moderate scale, and on Tees-side prices are easier. Heavy cast iron is about the firmest section of the market, sellers still realising 66s. 6d. for ordinary foundry grades and 68s. 6d. for good machinery quality. In the Midlands there is a fairly good demand for machinery cast-iron scrap in cupola sizes, and 70s. delivered is the general price asked, with 65s. for ordinary heavy cast-iron scrap, and 60s. for light metal. In Scotland the market for cast-iron scrap is more or less unchanged, and first-quality machinery metal, suitable for foundries, is quoted at 70s. to 71s. 3d., and ordinary cast iron at 64s. to 65s. Steelworks cast iron is at 62s. 6d. to 63s. 6d. Old cast-iron railway chairs are unchanged at 67s. 6d. to 68s., light cast iron at 60s. to 61s. 3d., and old cast-iron firebars at 58s. 6d., all per ton delivered works.

Metals.

Copper.—Closing last week with values slightly weaker, business in warrant copper has since continued with markets generally quiet and uneventful. So far as it is possible to estimate from statistics, it would appear from the recently published September returns that a position has now been arrived at in which the production is very near to balancing the demand. Furthermore, these facts serve to indicate that as concerns the near future, at least, there is very little reason to anticipate any important variation in values.

Closing quotations are :—

Cash.—Thursday, £72 8s. 9d. to £72 10s.; Friday, £72 2s. 6d. to £72 5s.; Monday, £71 2s. 6d. to £71 3s. 9d.; Tuesday, £71 11s. 3d. to £71 13s. 9d.; Wednesday, £73 1s. 3d. to £73 2s. 6d.

Three Months.—Thursday, £73 to £73 2s. 6d.; Friday, £72 15s. to £72 16s. 3d.; Monday, £71 11s. 3d. to £71 12s. 6d.; Tuesday, £71 16s. 3d. to £71 17s. 6d.; Wednesday, £73 8s. 9d. to £73 10s.

Tin.—The continued weakness of the market for standard tin has progressed so far unchecked, while prospects for the near future are difficult to conjecture. In the first place, stocks are rapidly increasing, and it is anticipated that heavy supplies will come forward in the near future, while, on the other hand, an increase in the consumption necessary to preserve the balance of supply and demand is by no means assured. Moreover, it was generally expected that consumers in America would be forced to enter the market for substantial tonnages, but at the moment, whether they are covered or not, there are no signs of activity in that direction.

Official closing prices :—

Cash.—Thursday, £187 15s. to £187 17s. 6d.; Friday, £184 15s. to £185; Monday, £181 10s. to £181 12s. 6d.; Tuesday, £182 to £182 5s.; Wednesday, £189 10s. to £189 15s.

Three Months.—Thursday, £192 to £192 5s.; Friday, £189 to £189 5s.; Monday, £185 10s. to £185 12s. 6d.; Tuesday, £186 to £186 5s.; Wednesday, £193 15s. to £194.

Spelter.—Business with consumers both in this country and on the Continent continues only moderate, and at present there seems little prospect of any recovery of importance in the near future.

Daily quotations are :—

Ordinary.—Thursday, £22 17s. 6d.; Friday, £22 12s. 6d.; Monday, £22 2s. 6d.; Tuesday, £22 2s. 6d.; Wednesday, £22 7s. 6d.

Lead.—Very little interest has been disclosed on the lead market during the past week. Consumers on the Continent are said to be not too well covered, and if this is so a revival in the demand from that quarter is quite possible.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £23 10s.; Friday, £23 10s.; Monday, £23 10s.; Tuesday, £23 10s.; Wednesday, £23 11s. 3d.

Students' Corner.

Q.—What are the methods of feeding to ensure soundness?

A.—One method is by the use of feeding rods, another method is by feeding heads, both having a supply of molten metal on the top of the castings.

Q.—Why will castings poured horizontally require a higher temperature iron than similar castings poured vertically?

A.—It is a question of location of runner gates. To put this matter in a simple way—molten iron, or any other liquid, will run down-hill quicker than up-hill. There is a great difference when a liquid drops down than when it is forced upwards. This is what exactly happens when a mould is poured vertically compared with the same mould being poured horizontally. As an example, take a cylindrical casting 12 in. dia. and 12 ft. long, such as a hydraulic cylinder, or ram, or a flanged pipe. When this is cast vertically the runner gates are situated at the top as it stands on end, the metal from the runner basin drops easily down. When this same casting is poured horizontally the runner gates are so arranged that some force is necessary to fill the casting.

Q.—Does the composition of the iron bear any relation to the extent of liquid contraction?

A.—The composition of the iron is a serious factor affecting variation in liquid shrinkage. Commercial cast iron contains 5 to 10 per cent. impurities, but they are necessary impurities otherwise the metal would not be cast iron, carbon, silicon, phosphorus and sulphur are the impurities referred to. The conclusions derived from a long and close observation are as follow : It is peculiar to white cast iron that it does not assume a pasty stage, or condition, for any length of time when cooling, *id est*, the metal changes from the liquid to the solid state in a very short time, consequently such a metal does not favour feeding with iron rods; hence feeding heads, similar to that practised with steel castings are arranged, so that at the moment the casting solidifies it will draw the metal from the feeding head into the casting as in malleable practice.

Grey iron assumes between the time of pouring and solidification a liquid and pasty condition for a considerable time, hence such condition favours feeding by iron rods.

Liquid contraction in relation to composition is such that with an extremely soft iron conforming to a No. 1 grade of any brand it will be greater than that of an iron conforming to a No. 4 grade of any brand of iron. To go to the other extreme the liquid contraction of a white iron would be about the same as a No. 1 grade, but the shrinkage hole, or shrinkage area, would assume quite a different aspect.

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A SAFE INVESTMENT

The safest investment in the world is one that saves you money you would otherwise lose.

Day in, day out, from year end to year end money is being wasted because some of the heat produced by burning coal or coke is allowed to escape into the atmosphere instead of being concentrated on its job.

A great part of this loss can be prevented by a coating of "INSULITE" cement or a layer of "INSULITE" bricks around or in the wall of the oven, furnace, kiln or stove in question.

It acts exactly like a tea cosy on a tea pot.

INSULITE BRICKS AND CEMENT ARE NOT EXPENSIVE.

We invite you to write us and see if they can be used to save money in your particular case.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	73	1	3
Three months	73	8	9
Electrolytic	83	15	0
Tough	75	10	0
Best selected	76	0	0
Sheets	110	0	0
India	92	0	0
Wire bars	84	5	0
Do. Nov.	84	5	0
Do. Dec.	84	5	0
Ingot bars	—		
H.C. wire rods	86	12	6
Off. av. cash, September	75	6	9 1/16
Do. 3 mths., September	75	19	4 1/2
Do., Sttlmnt., September	75	7	1 5/8
Do., Electro, September	84	12	9 1/2
Do., B.S., September	79	18	1 1/2
Do. wire bars, September	84	18	4
Aver. spot price, copper, Sept.	75	6	9 11/16
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11 1/2d.

BRASS.

Solid drawn tubes	12 1/2d.
Brazed tubes	14 1/2d.
Rods, drawn	12 1/2d.
Rods, extd. or rlld.	8d.
Sheets to 10 w.g.	11 1/2d.
Wire	11 1/2d.
Rolled metal	10 1/2d.
Yellow metal rods	8d.
Do. 4 × 4 Squares	8 1/2d.
Do. 4 × 3 Sheets	9d.

TIN.

	£	s.	d.
Standard cash	189	10	0
Three months	193	15	0
English	190	10	0
Bars	184	0	0
Straits	186	10	0
Australian	184	10	0
Eastern	186	10	0
Banca	194	0	0
Off. av. cash, September	204	18	9
Do., 3 mths., September	208	17	8 9/16
Do., Sttlmt., September	204	18	5 3/16
Aver. spot, September	204	18	9

SPELTER.

	£	s.	d.
Ordinary	22	7	6
Remelted	20	10	0
Hard	19	0	0
Electro 99.9	24	2	6
English	22	12	6
India	20	0	0
Zinc dust (Nom.)	32	0	0
Zinc ashes	—		
Off. aver., September	24	8	11 1/2
Aver., spot, September	24	4	2

LEAD.

	£	s.	d.
Soft foreign ppt.	23	11	3
English	24	5	0
Off. average, September	23	11	5 1/2
Average spot, September	23	11	1 7/8

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	31	10	0
Do. V.M. ex-whf.	30	0	0
Rods	34	0	0
Boiler plates	28	0	0
Battery plates	28	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	50	0	0
Chinese	30	15	0
Crude	20	15	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	15	0
45/50%	11	15	0
75%	19	0	0
Ferro-vanadium—			
35/50%	12/10 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/- lb. Mo.		
Ferro-titanium—			
23/25% carbonless	1/1 lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	3/3 1/2 lb.		
Tungsten metal powder—			
98/99%	3/6 1/2 lb.		
Ferro-chrome—			
2/4% car.	£31	0	0
4/6% car.	£23	2	6
6/8% car.	£21	17	6
8/10% car.	£21	7	6
Ferro-chrome—			
Max. 2% car.	£33	2	6
Max. 1% car.	£38	2	6
Max. 0.70% car.	£40	0	0
70%, carbonless	1/- lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/4 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/6 lb.		
Ferro-manganese (net)—			
76/80% loose	£13	10	0
76/80% packed	£14	10	0
76/80%, export	£14	0	0
Metallic manganese—			
94/96%, carbonless	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/4 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 7/16 in.	1/- lb.
Flats, 1/4 in. × 1/4 in. to under 1 in. × 1/4 in.	3d. lb.
Do., under 1/4 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				3	15	0
Bundled steel and shrngs.	3	11	0 to	3	14	0
Mixed iron and steel	3	7	6 to	3	10	0
Heavy cast iron	2	17	6 to	3	0	0
Good machinery for foundries	3	2	6 to	3	5	0
Cleveland—						
Heavy steel				3	6	0
Steel turnings				2	15	6
Cast iron borings				2	14	0
Heavy forge				3	17	6
W.I. piling scrap				3	10	0
Cast-iron scrap	3	6	6 to	3	8	6
Lancashire—						
Cast-iron scrap	3	2	6 to	3	10	0
Hvy. wrought				4	0	0
Steel turnings				2	17	6
Scotland—						
Heavy steel	3	12	6 to	3	15	0
Cast-iron borings				2	15	0
Wrought-iron piling				4	1	0
Heavy machinery				3	11	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	63	0	0
Brass	43	0	0
Lead (less usual draft)	20	10	0
Tea lead	17	0	0
Zinc	15	0	0
New aluminium cuttings	66	0	0
Braziery copper	56	0	0
Gunmetal	57	0	0
Hollow pewter	140	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	75/-
Foundry No. 3	72/6
Foundry No. 4	71/6
Forge No. 4	71/-
Hematite No. 1	77/-
Hematite M/Nos.	76/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/-
,, d/d Birm.	93/6
Midlands—	
Staffs. common*	—
,, No. 4 forge*	75/6
,, No. 3 fdry*	79/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—
* d/d Black Country dist.	
Scotland—	
Foundry No. 1	78/6
,, No. 3	76/-
Hem. M/Nos.	80/-
Sheffield (d/d district)—	
Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge	73/-
,, fdry. No. 3	77/-
E.C. hematite	87/6
W.C. hematite	89/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No 3 (special)	105/- to 107/6
Summerlee, No. 3	93/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	93/-
Monkland, No. 3	93/-
Shotts, No. 3	93/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.				10	15	0
Nut and bolt iron	9	0	0 to	9	5	0
Hoops				11	0	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip				11	0	0
Bolts and nuts, 1/4 in. × 4 in.				15	5	0
Steel—						
Ship plates	8	12	6 to	8	17	6
Boiler plts.	9	12	6 to	10	10	0
Chequer plts.				10	12	6
Angles				8	2	6
Tees				9	2	6
Joists				8	2	6
Rounds and squares, 3 in. to 5 1/2 in.				9	2	6
Rounds under 3 in. to 1/4 in. (Untested)				8	5	0
				and upwards		
Flats, over 5 in. wide and up				8	2	6
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs)				9	15	0
Black sheets, 24g.				10	7	6
Galv.cor.shts., 24g.	13	5	0 to	13	10	0
Galv. fencing wire 8g. plain				12	0	0
Billets, soft	6	5	0 to	6	15	0
Billets, hard	7	10	0 to	8	0	0
Sheet bars				6	5	0
Tin bars				6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6 1/2
Rods	1/5
Tubes	1/9 1/2
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4 1/2 to 1/10 1/2
To 15 in. wide	1/4 1/2 to 1/10 1/2
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5 1/2 to 1/11 1/2
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6 1/2
Ingots rolled to spoon size	1/1 to 1/9 1/2
Wire round—	
3/0 to 10 G.	1/7 1/2 to 2/2 1/2

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.90
Tank plates	1.95
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.75
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd, No. 13	2.35
Wire nails	2.45
Plain wire	2.40
Barbed wire, galv.	3.10
Tinplates, 100 lb. box	$5.35

COKE (at ovens).

Welsh foundry	27/6
,, furnace	22/6 to 24/-
Durham and North.	
,, foundry	22/6
,, furnace	21/-
Midlands, foundry	—
,, furnace	21/6 and up

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box	18/9
,,	28×20 ,,	37/6
,,	20×10 ,,	27/6
,,	18 1/2×14 ,,	19/6
C.W.	20×14 ,,	15/6
,,	28×20 ,,	34/-
,,	20×10 ,,	22/7 1/2
,,	18 1/2×14 ,,	16/-
Terneplates	28×20	33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	10	0
Bars, hammered, basis	£17	10	0 to	£18	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	15	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£20	0	0 to	£24	0	0
Bars and rods dead soft, steel	£11	0	0 to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65%	47½%
Water	61½%	42½%
Steam	57½%	37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Oct.	17	..	72	8	9	dec.	8/9
,,	18	..	72	2	6	,,	6/3
,,	21	..	71	2	6	,,	20/–
,,	22	..	71	11	3	inc.	8/9
,,	23	..	73	1	3	,,	30/–

Electrolytic Copper.

			£	s.	d.			
Oct.	17	..	84	0	0	dec.	5/–
,,	18	..	84	0	0	No change	
,,	21	..	84	0	0	,,	,,
,,	22	..	83	15	0	dec.	5/–
,,	23	..	83	15	0	No change	

Standard Tin (cash).

			£	s.	d.		
Oct.	17	..	187	15	0	dec.	40/–
,,	18	..	184	15	0	,,	60/–
,,	21	..	181	10	0	,,	65/–
,,	22	..	182	0	0	inc.	10/–
,,	23	..	189	10	0	,,	150/–

Tin (English ingots).

			£	s.	d.			
Oct.	17	..	187	15	0	dec.	50/–
,,	18	..	184	15	0	,,	60/–
,,	21	..	181	10	0	,,	65/–
,,	22	..	182	0	0	inc.	10/–
,,	23	..	190	10	0	,,	170/–

Zinc Sheets (English).

			£	s.	d.			
Oct.	17	..	32	0	0	No change	
,,	18	..	32	0	0	,,	,,
,,	21	..	31	10	0	dec.	10/–
,,	22	..	31	10	0	No change	
,,	23	..	31	10	0	,,	,,

Spelter (ordinary).

			£	s.	d.		
Oct.	17	..	22	17	6	inc.	1/3
,,	18	..	22	12	6	dec.	5/-
,,	21	..	22	2	6	,,	10/-
,,	22	..	22	2	6	No change	
,,	23	..	22	7	6	inc.	5/-

Lead (English).

			£	s.	d.		
Oct.	17	..	24	10	0	No change	
,,	18	..	24	15	0	inc.	5 –
,,	21	..	24	10	0	dec.	5/-
,,	22	..	24	10	0	No change	
,,	23	..	24	15	0	inc.	5/-

AVERAGE PRICES OF GALVANISED CORRUGATED SHEETS (NORTH OF ENGLAND).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	13 0 0	12 5 0	11 10 0	11 16 0	11 10 0	11 10 0	11 10 0	11 10 0	12 0 0	12 0 0	12 0 0	12 0 0	11 17 1
1902	12 0 0	11 10 0	11 10 0	11 10 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 14 2
1903	11 5 0	11 5 0	11 5 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 7 1
1904	11 5 0	11 5 0	11 5 0	11 5 0	10 15 0	10 15 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	10 5 0	10 15 0
1905	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	11 0 0	11 5 0	11 15 0	12 0 0	10 15 0
1906	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 12 6	12 12 6	12 15 0	12 15 0	12 15 0	13 5 0	12 12 11½
1907	13 5 0	13 5 0	13 15 0	13 15 0	13 15 0	13 15 0	13 17 6	13 17 6	13 17 6	13 2 6	13 2 6	13 2 6	13 10 10
1908	13 2 6	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 11 0½
1909	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 16 8
1910	11 15 0	12 5 0	12 5 0	11 15 0	11 10 0	11 10 0	11 12 6	11 12 6	11 12 6	11 12 6	11 10 0	11 10 0	11 13 4
1911	11 5 0	11 1 3	10 15 0	10 15 0	10 13 9	10 10 0	10 13 9	11 0 0	11 5 0	11 5 0	11 5 0	11 7 0	10 19 7½
1912	11 10 0	11 10 0	11 10 0	11 15 0	12 5 0	12 5 0	12 5 0	12 5 0	12 5 0	12 12 6	12 18 0	12 15 0	12 2 11½
1913	12 15 0	12 15 0	12 15 0	12 11 3	11 18 0	11 15 0	11 15 0	11 15 0	11 15 0	11 3 0	11 0 0	11 2 6	11 18 4
1914	11 7 0	11 7 6	11 7 6	11 5 7½	11 2 6	10 15 0	10 15 0	12 17 6	14 2 0	13 7 0	11 15 7	11 2 6	11 16 0
1915	11 10 8½	13 12 6	14 8 9	15 0 6	17 17 6	20 17 6	20 17 6	20 6 3	17 12 6	18 1 0	22 13 9	25 2 0	18 3 4½
1916	26 5 0	27 12 6	28 0 0	28 5 0	29 0 0	29 0 0	28 15 0	28 3 0	28 15 0	28 15 0	28 15 0	28 15 0	28 6 8½
1917	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 0 0	28 0 0	28 0 0	28 11 3
1918	28 5 0	28 15 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	28 13 4
1919	29 0 0	29 0 0	29 0 0	28 0 0	28 10 0	27 7 6	27 5 0	29 3 0	32 0 0	33 0 0	36 10 0	40 8 4	31 5 3½
1920	46 10 0	49 15 0	53 15 0	56 0 0	55 10 0	54 10 0	52 10 0	48 10 0	44 3 4	39 2 6	35 17 6	30 8 0	47 4 3
1921	28 10 0	25 17 6	24 5 0	23 3 4	22 0 0	22 0 0	23 10 0	21 12 6	20 0 0	18 15 0	18 3 9	17 2 0	22 1 7
1922	16 17 6	15 13 9	16 3 0	16 10 0	16 4 4½	15 15 6	15 16 3	16 16 0	16 8 9	16 6 3	17 1 0	17 7 6	16 7 5½
1923	18 3 1½	19 1 11½	19 8 0	19 10 0	19 7 0	19 1 3	18 0 0	18 13 1½	19 0 0	19 3 9	19 2 6	18 19 4½	18 19 2
1924	18 13 6	18 9 4½	18 5 0	17 15 11½	17 3 0	17 19 4½	18 7 6	18 8 1½	18 8 1½	17 19 6	17 11 3	17 10 0	18 0 10½
1925	17 8 6	17 1 6½	16 9 4½	16 12 0	16 9 8½	16 9 4½	16 0 6	16 1 10½	16 5 0	16 7 0	16 12 6	6 15 0	16 11 0½
1926	16 14 4½	16 5 7½	16 0 6	15 11 10½	15 11 3	16 0 0	16 16 0	16 18 9	16 14 0	16 18 9	17 10 0	6 19 0	16 10 0½
1927	16 3 1	15 7 6	15 3 3	15 3 1½	14 14 4½	14 11 6	14 1 10½	14 0 0	13 19 6	13 16 10½	13 13 1½	13 3 9	14 9 10
1928	13 0 0½	13 2 6	13 6 0	13 2 6	13 3 0	13 6 9	13 11 3	13 10 0	13 10 7½	13 12 6	13 11 6	13 10 0	13 8 8½
1929	13 11 0	13 13 1½	13 12 9½	13 10 11½	13 9 3	13 8 9	13 11 6	13 7 6	13 7 6	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

XUM

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

BRASS FOUNDRY FOREMAN requires situation; 18 years last place, 7 years foreman, with turbine and electrical firm; age 40.—Box 370, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN in Midlands seeks re-engagement in general engineering and jobbing grey-iron foundry; 18 years' experience; good references.—Box 358, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PATTERN FILER wanted, used to iron and iron ferrous patterns. Plate and stripping plate experience necessary. Single man preferred.—Apply, stating age, wage, experience, Box 362, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PATTERN FITTER wanted, experience in setting up patterns on stripping plate machines. Single man preferred. Steady employment to good man.—Apply, stating age, wage, experience, Box 364, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

SUPERINTENDENT required for modern Foundry attached to important textile works in Manchester district producing both textile and machine tool castings. Must have an all-round experience in green sand, dry sand and loam, for repetition and jobbing castings; efficient organiser for maximum output and possess a sound knowledge of ferrous and non-ferrous alloys. A man with some metallurgical and laboratory training preferred.—Apply in confidence, giving age, experience, references, and salary expected, Box 338, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Charge-hand Foreman for Steel Foundry near London district; must be used to small castings; good prospects.—State experience, wages, etc., to Box 344, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PARTNERSHIP.

SMALL Foundry Owner (freehold property), maker of diaphragm pumps and general engineering work up to 15 cwts., requires a Partner experienced in foundry practice, practical or commercial, with £750 to invest, for the manufacture of chill cast phosphor-bronze and gunmetal rods, also other engineering repetition lines in ferrous and non-ferrous, to produce a finished machined article.—Box 360, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

BUSINESSES WANTED.

TO NON-FERROUS METAL FOUNDRIES.—London Syndicate desire to acquire by purchase outright or by other mutually agreed arrangements established Foundries (small or large) casting in any or all non-ferrous metals. Transfer could include retention of present staff and management if desired. Replies to this will be treated in strict confidence.—Box 366, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

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